Assessing the role of the export sector in Mexican economic development, 1965-2014

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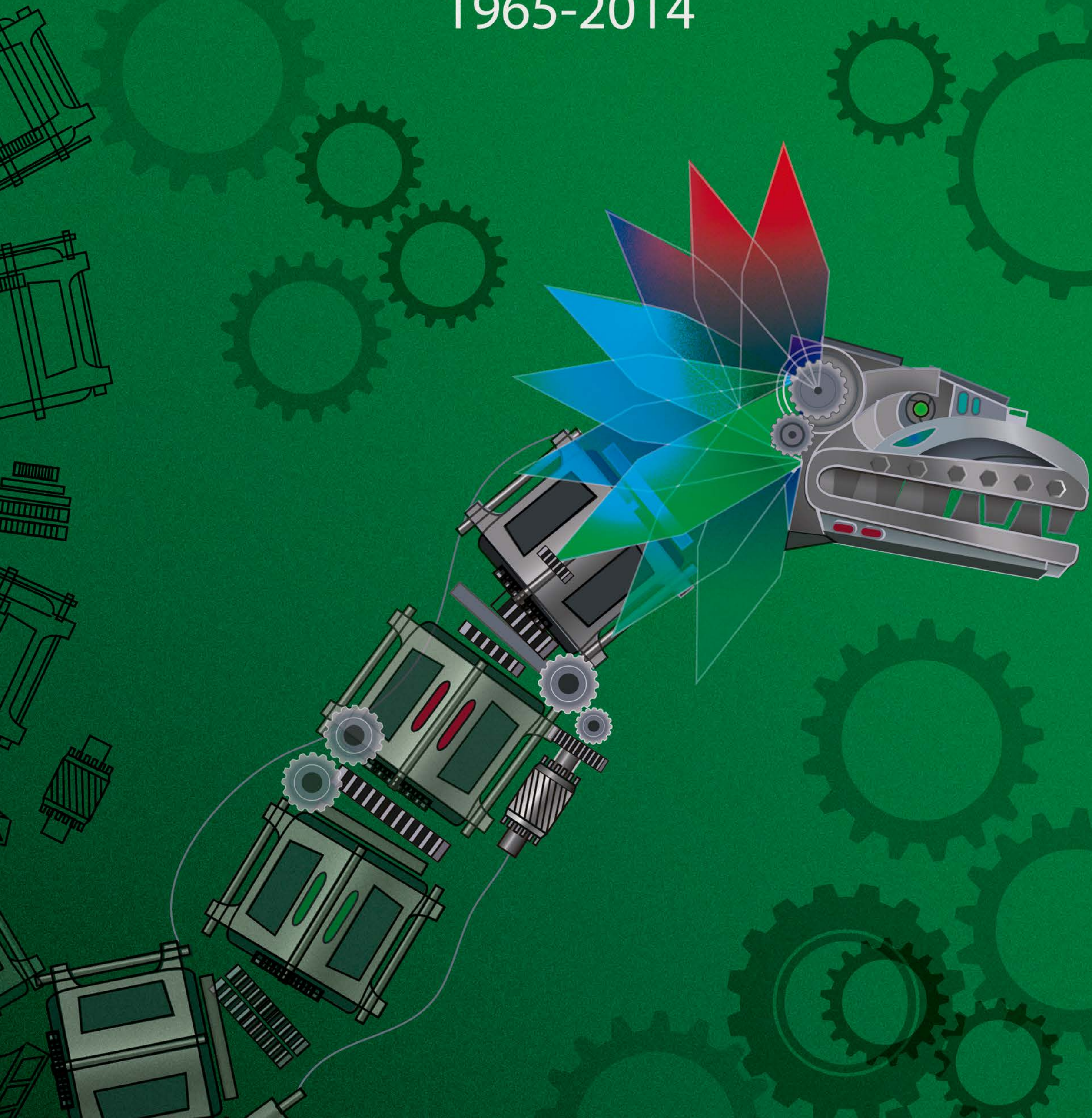

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ASSESSING THE ROLE OF THE EXPORT SECTOR IN MEXICAN ECONOMIC DEVELOPMENT, 1965-2014.

DISSERTATION

to obtain the degree of Doctor at Maastricht University, on the authority of the Rector Magnificus, Prof. Dr. Rianne M. Letschert in accordance with the decision of the Board of Deans, to be defended in public on Wednesday 13 June 2018, at 10.00 hours

by

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Prof. Dr. Bart Los, University of Groningen.

Prof. Dr. Roberta Rabelloti, Università di Pavia.

Prof. Dr. Carlo Pietrobelli, UNU-MERIT.

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This book marks the end of a rather long journey that started back in February 2007, when I had the opportunity to participate in a research project on the participation of Mexico in international production networks. For myself, such an amazing (and sometimes hard) journey has not only implied living, studying and working in different and countries. It has also been a unique opportunity to advance my knowledge in international economics, understand different cultures and points of views, as well as meeting a lot of great people from different parts of the World (economists and non-economists alike). Furthermore, this journey has been a challenging experience where, more than ever in my life, I have learned to appreciate those little (and scarce) moments that I get to spend with my family and friends in Mexico and, with all that wonderful people that I met (and had a great time with) during the different stages of our lives.

I am deeply grateful for all the things I learned over these last years and for all the support from my loved ones in difficult times. I am also indebted to those that were willing to share their advice, time, patience and wisdom no matter how lost I was. To those that spent time with me travelling over long distances, with this not only being a holiday journey or a bike ride, but also the pursuing of a two-year research master, a five-year PhD thesis as well as the difficult endeavor which implies start living in a foreign country from scratch. To that amazing people who, for different reasons, were not entirely able to share their time and support but that have always remained in my life as a continuous source of inspiration. I also extend my gratitude to those that trusted in my words, that had a drink with me every now and then, that laugh at my (not so good) jokes and that were willing to check on me and bring their words of wisdom no matter how unavailable, busy or worried I was. I will always be grateful to my old friends that despite the physical and time distance have always tried to be there to cheer me up and bring their love and encouragement whenever I need it. Likewise, I already have special place in my heart for those new friends that received me in their lives. You guys received me with arms wide opened not only to give me a warm and sincere hug, but also to show me the very best of you, even inviting me to spend time with your families and loved ones, after knowing (and understanding) how hard It has been for me to be away from my loved ones for so long.

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"No te rindas, aún estas a tiempo de alcanzar y comenzar de nuevo, aceptar tus sombras, enterrar tus miedos, liberar el rastre, retomar el vuelo. No te rindas que la vida es eso, continuar el viaje, perseguir tus sueños, destrabar el tiempo, correr los escombros, y destapar el cielo.

No te rindas, por favor no cedas, aunque el frio queme, aunque el miedo muerda, aunque el Sol se esconda, y se calle el viento. Aún hay fuego en tu alma, aún hay vida en tus sueños.

Abrir las puertas, quitar los cerrojos, abandonar las murallas que te protegieron, vivir la vida y aceptar el reto, recuperar la risa, ensayar un canto, bajar la guardia y extender las manos, desplegar las alas, e intentar de nuevo, celebrar la vida y retomar los cielos. Porque cada día es un nuevo comienzo. Porque esta es la hora y el mejor momento".

Geneva, Switzerland
May,2018.

Summary.

The main objective of this thesis is to identify the existence of a process industrial upgrading in Mexico's exporting sector from 1965 to 2014. Four dimensions of upgrading are here assessed: (1) domestic content of manufacturing exports; (2) value added to output ratios; (3) labor productivity, and; (4) participation of skilled-labor. The period of time here studied starts from the first policy attempts to incentivize manufacturing production between firms Mexico and in the United States (i.e. the establishment of the Maquiladora program in 1965), until a period of time where manufacturing became widely fragmented across many countries and regions of the World economy (2014).

In order to meet this objective, this dissertation relies on specific aggregate and firm-level information for Mexico's exporting firms. Aggregate information includes international trade statistics, national input output tables and data in terms of Mexico's national accounting systems that is also classified per manufacturing sector. Such aggregate information is also here linked with additional data provided by major multi-regional input-output datasets. On the other hand, the firm-level information here used corresponds to the official panel datasets for the firms in Mexico that were registered in export promoting programs from 1990 to 2014.

Exporting firms in Mexico are here classified according to the export promotion framework that they belong to. Firms exclusively producing for exports are those included in the Maquiladora program (1965-2006), while firms producing both for exports and for the domestic market were included in the PITEX program (1985-2006). By 2007, to further strength the competitiveness of the exporting sector, policy makers merged those two export promoting programs into a single framework (known as IMMEX). In addition, this dissertation also takes into account other two types of firms: 1) the official data for firms in Mexico that are highly engaged in international production networks (i.e. the concept of Manufactura Global), and; 2) the rest of firms that are located in Mexico's domestic manufacturing.

Upgrading in exporting firms is here analyzed considering the following perspectives. I first start with the policy perspective (Chapter 2). In general lines, Chapter 2 argues that Mexico's policy framework has prioritized higher employment, output and higher levels of foreign direct investment in the exporting sector at the expense of upgrading. Official attempts to develop a network of domestic suppliers have been observed from the opening of the Mexican economy to foreign markets (1982). Nevertheless, the vast majority of exporting firms are reluctant to source inputs domestically as domestic supplier are unable to meet high quality and delivery standards.

A global perspective of manufacturing production is discussed in Chapter 3. Here, I indicate that all advanced and developing economies in the World economy are experiencing decreasing domestic content in their production for final manufacturing output. Depending on the specific characteristic of each manufacturing sector, the main

source of such decreasing domestic content in final output could be either a higher interaction with foreign suppliers located at the country's same region, or a higher interaction with suppliers located in other major regions of the World economy. Firms operating in the sector of electronics, textiles and other manufacturing that are located in advanced and emerging economies are more prone to increase their interactions with foreign suppliers that are outside of their region of origin. For the rest of manufacturing sectors in advanced and emerging economies, and for the manufacturing production in the rest of the developing World, the main source of decreasing domestic content will be higher interaction with regional suppliers.

A long-run perspective on the aggregate evolution of the domestic content of Maquiladora exports, and on their use of highly skilled workers, is presented in Chapter 4. I indicate that such domestic content presents a continuous decline since Mexico decided to open its domestic market in 1981. Such situation was still present by the end of the Maquiladora program (2006). External shocks and key policy changes (both taking place in 1982 and 1994) as well as the composition of Maquiladora output (which is mostly consistent of electronics) largely account for this continuous decline.

Chapter 5 further assesses domestic content embodied in Mexico's final manufacturing output by taking into account the specific country of origin where value added was originally created. With this analysis, I indicate that manufacturing firms in Mexico can participate in local, regional and global value chains. Local value chains are the predominant type of organization for firms in domestic manufacturing as they mostly source their input from local producers in Mexico. Exporting firms, on the other hand, can participate in local regional or global value chains depending on the manufacturing sector being analyzed. Regional value chains are mostly observed in the textile sector in light of the increasing presence of value added coming from the United States. Global value chains are mostly observed at the electronics sector given the important participation of East Asian firms in the production for exports within this sector. The production for exports within the transport sector mostly relies on domestic suppliers and, thus, we infer that the predominant type of production here is local value chains.

Labor productivity in exporting firms is analyzed in Chapter 6. In this chapter, I show that the exporting sector does not contribute much to changes in aggregate labor productivity for total Mexican manufacturing. Manufacturing firms in the domestic sector are the ones driving changes in aggregate labor productivity. Upgrading in the exporting sector (i.e. value added to output ratios) does not play an important level in inducing aggregate productivity changes. At the firm-level, we also observe that value added to output ratio do not show any relevant variation over time.

Two main conclusions are obtained from this dissertation. The first one is that the exporting sector has transformed Mexico in a top manufacturing powerhouse for the World economy. The combination of thoroughly elaborated export promoting policies, trade agreements, unique access to the US market, as well as the intention to fully exploit the set of country-specific competitive advantages enjoyed by Mexico are the main factors that help us understand such important achievement. On the other hand, by means of any relevant indicator studied by this dissertation, Mexican manufacturing has clearly failed to induce a substantial transformation of its exporting sector towards more complex and technologically advanced manufacturing activities. A process of industrial upgrading that could allow the exporting sector in Mexico capture a higher amount of benefits in the current context of international fragmentation of production is still far from being present.

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Chapter 1

Introduction.

The main objective of this thesis is to study the process of industrial upgrading in Mexico's export sector (maquiladora industry) at the aggregate and firm-level. In this regard, this introductory chapter presents two key arguments. The first one is that the Mexican maquiladora industry should be regarded as an exception to Latin America's failure to industrialize, given the continuous growth in output and employment that can be observed in recent decades. The second argument is that, despite success in production for exports, firms participating in the Maquiladora industry have failed to replace imported intermediates by domestically produced intermediate inputs, produced by non-maquiladora manufacturing firms. Thus, Mexico and its export sector are still far from the joining the highly-industrialized World in the way its East Asian counterparts did.

In this context, this dissertation will tackle two general research question; (1) what are the main factors at the aggregate and firm-level that explain upgrading (or the lack thereof) in Mexico's maquiladora industry over time?; (2) which are some of the key policy lessons from Mexico's exporting sector that can be used by other developing countries wishing to increase their production for exports and achieve higher levels of manufacturing employment?.

This chapter is structured as follows. Section 1.1 briefly discusses the increasing fragmentation of production, which stands as the predominant type of organization to produce manufacturing goods. Section 1.2 provides our definition of upgrading, i.e. the different dimensions from this concept that will be explored during this dissertation. Section 1.3 focuses on export processing zones as an alternative for developing countries to participate in fragmented global value chains. Section 1.4 presents the factors that account for Latin America's failed attempt to industrialize by means of export processing zones. Section 1.5 indicates the reasons why we believe the Mexican maquiladora industry is an exception to the Latin American case, which also motivates the writing of this dissertation. Finally, section 1.6 indicates the structure of this thesis.

1.1 Increasing Fragmentation of Global Production.

Revolutionary progress in communication and information technologies has enabled a historic (and ongoing) breakup of manufacturing production (Grossman & Rossi-Hansberg, 2008; Baldwin et al.,2011). This process is called "fragmentation" (Jones, 2000) and has become an important feature of the structural interdependence of the World economy (Arndt & Kierzkowski, 2001). In this fragmentation of production, advanced and developing economies specialize in particular stages of the productive sequence according to their factor endowments or productivity levels. For instance, capital intensive countries will mainly specialize in the stages with higher technological complexity, while the less developed economies will specialize in assembling given their labor-intensive factor endowments. This whole situation implies that most of the manufacturing goods will be no longer completely produced by a single country but will be generated by plants in many different nations that develop different patterns of specialization.

1.2 Definition and Dimensions of Upgrading.

Participating in the increasing fragmentation of global production implies new challenges for developing economies. Not only should these countries seek for alternatives to join international production networks but, more importantly, they should also aim to upgrade their manufacturing production in order to foster innovation and get industrialization started. Correctly defining and measuring the process of upgrading experienced by a given developing country is, however, far from straightforward (De Vries et al., 2016). This is because such process of industrial upgrading can be measured by considering information at the firm-level and/or at the aggregate level. Let us further elaborate on this issue.

On the one hand, Porter (1990) and Kaplinsky (2000) indicated that upgrading can refer to the process by which a given firm learns how to make better products (that are also more efficiently produced) and, that implied moving from low-skilled to more high-skilled activities. Humphrey and Schmitz (2002) went one step further and defined upgrading in the context of the competitive pressures faced by firms as a result of the emergence of global value chains. In their view, upgrading implies a shift in activities where firms seek to increase or maintain its income levels given stiff competition in international markets. Those shifts can be an increase in the skilled content of their activities and/or the transit to market niches with higher entry barriers that are somehow insulated from competitive pressures.

On the other hand, studies relying on aggregate information mostly stress the importance of value added embodied in final output as a sign of upgrading. We are here referring to all those studies that rely on Input Output tables (IOTs) and that implement methods similar to that of vertical specialization (Hummels et al., 2001) to identify domestic content in exports (De la Cruz et al, 2011; Los et al., 2013; Koopman et al., 2014; Los et al.,2016) . Higher domestic content in exports implies the ability to integrate local producers of intermediate inputs in global value chains away from the simple specialization in assembling activities. Higher local content in final exports thus also implies higher benefits for the rest of economy as this induces a learning process where domestic producers acquire the capabilities to locally generate inputs of high technological complexity. Nonetheless, in my view, additional factors have to be taken into consideration when inferring upgrading (or downgrading) by simply looking at the domestic content of exports. For instance, decreasing value added content does not always have to refer to downgrading. One could imagine that in spite of declining domestic value added content, gross value added and value added per worker can be increasing. Lower value added content might simply be the logical consequence of globalized production and do not necessarily lead to decreases in the technological content of inputs.

All these perspectives call for a careful definition of upgrading that considers its different positive aspects (that can be observed at the micro and aggregate level) and, that stresses its importance as the key strategy for developing economies to join the highly-industrialized World. In my view, the general process of industrial upgrading implies a greater use of domestic inputs with higher technological content, higher interaction of the export sector with domestic suppliers, the development of more domestic suppliers, increasing levels of labor productivity, greater use of more qualified labor and so forth. Thus, in the present dissertation we propose four key dimensions of upgrading that try to capture the aforementioned views.

The first dimension of upgrading is measures for the domestic content of exports that capture the contribution of local producers of domestic inputs and of indirect exporters. In this first dimension of upgrading, we are considering the value added contribution in final output from firms assembling intermediate inputs, as well as the value added generated by local producers that produced domestic inputs to be used in the production for exports. This first dimension of upgrading goes in line with the above-mentioned aggregate studies that implement measures of vertical specialization by relying on IOTs. To study the micro tendency of this aggregate indicator we proposed the firm-level value added to output ratio as a second dimension of upgrading. Calculating for a specific firm its value added contribution, and the one from its indirect exports, that is embodied on its final output (as can be done for the sum of all firms at the aggregate level) is simple quite impossible. Therefore, this second dimension of upgrading act as a complement to the first dimension by only taking into account the gross value added generated by a given exporting firm.

Following the same stream of ideas, our third dimension of upgrading tackles measures of labor productivity at the export sector, given the expected increasing efficiency that emerges as a result of technological learning and increasing competition at international markets. Our fourth dimension of upgrading is the use of more highly-skilled labor in the production process, which is necessary to shift from low to more advanced manufacturing techniques. These last two dimensions of upgrading can be measured both at the aggregate and firm-level and are here included to the follow the aforementioned concepts proposed by Porter (1990), Kaplinsky (2000) and Humphrey and Schmitz (2002). In my view, the presence of all these four dimensions should be taken into account when inferring upgrading (or downgrading) in the manufacturing production of any given developing economy.

1.3 Export Processing Zones as a Policy Instrument for Participating in International Production Networks.

Export Processing Zones (EPZs) constitute an alternative for developing economies to participate in the increasing fragmentation of manufacturing production. EPZs can be defined as industrial zones where special incentives (such as tax holidays and duty free imports and exports) are provided to firms as long as most, if not all, of the processed goods are exported. Developing economies face both advantages and disadvantages if they decide to implement EPZs. According to Sargent and Mathews (2001), EPZs can benefit the host country due to their capacity to increase exports, create employment and provide foreign exchange. Nevertheless, the multinational enterprises (MNEs) that participate in these schemes tend to retain the most knowledge intensive manufacturing activities in the highly industrialized advanced economies. The more labour intensive fragments of the value chain are located in the export processing zones of developing countries (Gallagher and Zarsky, 2007). Therefore, the manufacturing production resulting from EPZ contributes less to GDP than ordinary exports as it mostly performs labor intensive activities, uses little domestic inputs and strongly relies on imported inputs with high technological complexity (Johanssen & Nilsson, 1998). In this context, the challenge for the industrial development of developing economies is to successfully move from the labor-intensive activities of manufacturing to those with higher technological content.

1.4 Latin America's Failing Attempt to Industrialize with Export Processing Zones.

Among others, by means of EPZs, East Asian countries (Korea, Taiwan, Hong Kong and Singapore) were able to transform themselves from technologically backward and poor, to relatively modern and affluent economies (Nelson & Pack, 1999; Gallagher & Shafaeddin, 2010). In contrast, many Latin American countries failed to industrialize on the basis of EPZs. According to Wilson (1992) there are several factors and historical reasons to account for this issue. First of all, governments in Latin America had a deep and prolonged commitment to Import Substitution Industrialization (ISI) as the primary strategy for industrial development. Even though East Asian countries also followed ISI, they maintained an authoritarian control over the labor force and were strongly involved in the promotion of the export sector. Next, unlike East Asia, the implementation of EPZ in Latin America was never part of a national strategy of export-oriented manufacturing. EPZs in Latin America usually emerged as a development strategy for a particular region (Manaus in the Brazilian Amazon) as labor surplus region (the northern part of Mexico as a result of the end of the bracero program in the US), or a geopolitically strategic region (Arica and Punta Arenas in the northern and southern borders of Chile). Historical reasons also played an important role. Unlike Spanish domination in Latin America, Japanese colonial rule in Taiwan and Korea had left a substantial manufacturing infrastructure. Similarly, British colonial rule in Singapore and Hong Kong had left an export-oriented infrastructure of transportation and communication and financial services. The influx of entrepreneurs, professionals and skilled workers from China and North Korea to these countries as well as massive US foreign aid helped promote financial and industrial development.

1.5 Mexico and the Success of Maquiladora Production.

Despite the relative failure of export-oriented industrialization in most Latin American countries, the EPZ in Mexico stands out as an important exception[1]. Mexico's EPZ is

[1] According to Jenkins et al. (2001), EPZ activity in Latin America is highly concentrated in three countries; Mexico, Brazil and, The Dominican Republic. Those authors also indicate that the maquiladora program in Mexico alone accounts for over 65% of the employment in EPZs in the region.

commonly referred to as "Maquiladora Industry" or simply "Maquila". Mexico's maquiladora industry is one of the oldest and one of the largest international production networks in the World. The maquiladora industry in Mexico was established during the 1960s with two plants and a limited number of employees manufacturing televisions and plastics (Carrillo, 2007). Nowadays, this industry accounts for about 55% of Mexico's manufacturing exports, produced by 2 million workers in 5,113 maquiladora firms (INEGI, 2011). According to the Secretaría de Economía (2016), i.e. Mexico's Ministry of Economics, by 2015 Mexico was the largest exporter of manufactured goods in Latin America and produced more than half of the medium and high-tech goods generated within this same region. Similarly, the Ministry of Economics also indicates that considering the value of exports as a percentage of GDP, Mexico is the third largest exporter of medium and high-tech goods just after Germany and South Korea. The success of Mexico's exporting sector is of such importance that by 2016 it became one of the key negative targets in the US presidential election and, by 2017-2018 it will also be one of the key factors to be debated during the renegotiation of NAFTA.

In my view, country specific features, preferential access to the US market and institutional settings account for the success of the maquiladora industry (and of Mexico's export sector) when compared to the rest of countries in Latin America. Apart from its abundance of cheap labor, its growing middle class and the relative political stability in this country (one party ruling for 70 years), the most important country specific explanation for the success of Maquiladora is its proximity to the US market. The fact that foreign assembly firms could be established in the northern part of Mexico greatly facilitated the re-organization of manufacturing firms. The Mexican maquiladora is an attractive program for US firms that cannot (or do not wish to) reallocate production to East Asia. It is also an attractive program for other Asian and European firms that seek to access the US market.

Also, maquiladora production has always enjoyed preferential access to the US, even before the signing of the North American Free Trade Agreement (NAFTA). In fact, one of the primary reasons for US assembly firms to initially relocate to the northern part of Mexico during the 1960s was to benefit from US regulations that allow the free imports of final goods that contain components produced in the US. When entering the US market, those goods were only going to be taxed on the non-US value added. The increasing outward orientation from Mexico and the signing of NAFTA largely increased the preferential treatment accorded this industry.

Finally, there is one important institutional arrangement that explains the success of the Mexican export sector as a whole. Policy makers in Mexico also designed a legal framework similar to the maquiladora but aimed at supporting firms in domestic manufacturing. This is the reasoning behind the Program for the Temporary Import of Exporting Goods (PITEX). Here, the main objective was to make firms in the domestic manufacturing (that produce both for domestic consumption and for export) as competitive as the foreign assembly firms belonging to the maquiladora program. Supporting two different export promoting programs for two different types of firms is an appropriate idea, given the differences in initial conditions, different needs and challenges faced by different types of firms. Eventually those two export promoting programs were merged into a single framework (the IMMEX program), which was also a good idea as this was meant to increase the interaction between different types of firms and the competitiveness of the export sector as a whole. In this context, it can be argued that even though Mexico did not enjoy some of the historical features that characterized the development of East Asian countries and lacked a long-term vision to implement the maquiladora program at the national level (beyond the border region), this country succeeded in becoming a global manufacturing power by following a set of policy steps in line with the country's geographical position and endowments.

The success of maquiladora production is, however, incomplete without a process of industrial upgrading. As mentioned before, upgrading in manufacturing is the key strategy for developing economies to join the highly-industrialized World. Therefore, the main objective of this thesis is to assess the presence of different four dimensions of upgrading in maquiladora production (as proposed in section 1.2) by relying on different sources of information at the aggregate and the firm level.

Exploring the reasons that prevent a developing economy achieving a process of industrial upgrading is of prime importance. More and more developing economies are currently seeking to participate progressively more in international production networks. Nevertheless, the stiff competition triggered by major low costs producers (such as China), the control and governance of global value chains by multinational firms, as well as the continuous innovation taking place in most manufacturing sectors limit the ability of developing countries to benefit optimally from the fragmentation of production. In a nutshell, many developing economies would like to obtain more benefits from its participation in EPZs beyond higher levels of employment and foreign exchange. The experience of Mexico's export sector in the development of its maquiladora industry can contribute to this debate.

Our thesis makes a novel contribution in that it uses all the available aggregate and micro information to study Mexico's exporting sector over a long period of time. At the aggregate level, we rely on official data for maquiladora and for the IMMEX program reported in terms of Mexico's national accounting system from 1981 to 2014. We also utilize official input-output tables for maquiladora and for the domestic economy of Mexico (for the benchmark year 2003), bilateral trade statistics by country of origin for maquiladora and for the rest of economy from 1998 to 2011, as well as the latest attempt from Mexico's statistical office to analyze, at the aggregate level, the participation of Mexico in global value chains (the concept of Manufactura Global). This specific aggregate information to study Mexico's exporting sector is complemented with other multiregional input output datasets. We are here referring to the EORA dataset (1990 and 2001) and the World Input Output tables (1998-2011). Finally, we also rely on the raw microdata that was used to create aggregate information for the Maquiladora and IMMEX program. This means that we utilize the official maquiladora firm-level dataset from 1990 to 2006 and the official panel dataset for the IMMEX program (2007-2014).

1.6 Thesis Outline.

This thesis is structured as follows. We first present our literature review on the evolution of export promoting programs in Mexico during the last 50 years (Chapter 2). Then, we analyze the domestic content of Mexico's export sector in three aggregate perspectives and one micro perspective. The first aggregate perspective is a global perspective. Here, the performance of Mexican manufacturing is analyzed in the context of the evidence from other major exporters and all the regions in the World economy (Chapter3). The second one is a historical perspective. The objective there is to analyze the evolution of the domestic content of exports of maquiladora from 1981 to 2006 (Chapter 4). The third one is the current perspective. Given the increasing existence of international production networks, we study the interaction of Mexico's export sector with other local and foreign producers (Chapter 5). Finally, we provide a micro perspective to account for the foundations of productivity growth in Maquiladora and the IMMEX from 1990-2014 (Chapter 6). In the next lines, we briefly summarize the main ideas behind each chapter included in this dissertation.

Chapter 2 presents a review of the literature on fifty years of export promoting policies in Mexico. This literature review constitutes our general framework for understanding the evolution of the Maquiladora program and of other export promoting programs in Mexico (the PITEX and IMMEX programs). In this chapter, we study the evolution of the legal framework governing the maquiladora since its inception in 1964, the observed adjustments and modifications that were implemented as a result of Mexico's opening up to foreign markets (1983), and as result of joining NAFTA (1994), the merging of the maquiladora program with PITEX firms (IMMEX program) in 2007, as well as Mexico's latest attempt to industrialize its southern region (the Special Economic Zones program released by 2016). Issues such as the location of maquiladora firms, the development of local suppliers, domestic sales and policies per manufacturing sector are discussed. In addition, this chapter discusses the main differences between firms participating in Maquiladora and those belonging to the PITEX program, as well as the policy reasoning behind the merging of those two into the IMMEX program.

Chapter 3 analyses the current context of manufacturing production for most countries in the World economy. Here, we argue that to produce final output many countries in the World economy have mostly relied on production networks located within the same region. Over the years, the increasing fragmentation of production has only helped to increase such intra-regional interaction. To analyse these trends, this chapter provides empirical evidence for the structure of value added (by country of origin) embodied in the final output generated by the World's top exporters of manufacturing goods. We extend this analysis to all the regions in the World economy (including those in Asia, Africa, Oceania, as well as Central and South America). According to our calculations, by 2011, Mexico stands as one of the top exporters of manufacturing goods (all sectors) and one of the largest exporters in the transport equipment sector. Its increasing interaction with its NAFTA counterparts largely accounts for this issue.

Chapter 4 provides the historical framework for the evolution of Maquiladora production. In this chapter, we assess the domestic value added embodied in maquiladora exports during the period from 1981 to 2006. The objective here is to analyze how the domestic value added in maquiladora changed at the aggregate level, as a result of external factors such as the opening up of the economy (1983), the signing of NAFTA (1994) and the industrial emergence of China (2001). We observe drastic declines in the domestic value added content of exports during 1983 and 1994, which also coincides with major currency crises in Mexico (debt crisis in 1983 and Tequila crisis in 1994). Overall, our calculations indicate a long-run decline in the aggregate domestic content of exports (from 31% in 1981 to 21% in 2006), which is largely driven by the falling domestic value added content within the electronics sector.

Chapter 5 studies the current aggregate interaction of maquiladora firms with other firms in the rest of the economy and with foreign suppliers located in major regions of the World economy. In this chapter, we decompose the final output produced by maquiladora producers into the value added contribution of domestic suppliers and other foreign suppliers by country of origin. Following the same reasoning, we also identify the value added contribution from domestic and foreign suppliers (by country of origin) that is embodied in the final output produced by domestic firms, as well as the one observed in the final output produced by all Mexican firms (maquiladora and domestic firms). To this end, the input-output tables that were used in chapter 4 are now included into a larger multiregional dataset (the World Input Output Tables). Our findings indicate that depending on the type of production (for export or domestic use) and manufacturing sector, maquiladora firms will participate in local, regional or global value chains. More importantly, in the production for exports we observed that foreign value added structure by country of origin suffered drastic changes while the value added contribution by domestic suppliers basically remained unaltered. Higher presence of East Asian value added in Mexico's export sector is here associated to US firms reallocating intermediate production to China and Asia.

Chapter 6 provides the micro level evidence for firms within the Maquiladora and IMMEX program from 1990-2014. In this chapter, we first study at the aggregate level, the contributions of exporting firms and domestic firms aggregate labor productivity over time. In our aggregate decomposition, we indicate that the non-maquiladora part of the Mexican economy is far more important to increase aggregate productivity than the maquiladora part. Our upgrading variable (value added to output ratio) shows negative and smalls contributions to changes in aggregate labor productivity levels for total manufacturing. In 24 years of analysis there is not much change in the value added output. In my view, one of the main implications from the lack of upgrading is to limit the contribution from labor productivity at the export sector to changes in the aggregate labor productivity in total manufacturing. At the firm-level, we find that the firms in the maquiladora dataset (up to 2007) are rather different from firms in the IMMEX dataset (from 2007). We identify GVC-intensive and non-GVC intensive firms in the IMMEX dataset, and find differences between them, and relative to the maquiladora firms, in terms of the microeconomic determinants of labor productivity.

Chapter 7 presents our conclusions. This last chapter also provides some insights about the Maquiladora industry (derived from this dissertation) to be considering during the 2017-2018 renegotiation of NAFTA.

Chapter 2.

50 years of Export promoting Programs in Mexico (1965-2016): A general Framework to Understand the Evolution of Maquiladora, PITEX and the IMMEX program.

2.1 Introduction.

The main objective of this literature review is to understand the different policy strategies that Mexico has followed to promote its production for exports. During the last 50 years, Mexico has devised different policy instruments to support exporting firms (both foreign and domestic owned) as well as local suppliers to these firms (indirect exporters). Such export promoting policies have changed given Mexico's different industrialization strategies, the international trade agreements that this country has signed, as well as the competitive pressures that Mexico has faced. When the engine of growth was supposed to be found in the domestic market (Import Substitution Industrialization), foreign exporting firms received limited support. Exporting firms in Mexico were supported initially within the Maquiladora program. In such export promoting program, foreign firms were entitled to import intermediate inputs and capital goods free of duty as long as their final output always reach foreign markets (i.e. there was no competition with domestic firms). Nevertheless, no additional support was provided to induce technological learning or a greater use of domestic inputs within the maquiladora program. This restrictive framework for exporting firms radically changed once the Import Substitution Strategy failed, and Mexico aimed for an industrialization strategy based on the production for foreign markets.

To ensure an increasing and successful production for exports, the Mexican government decided to renovate its Maquiladora program and to create a new program (similar to the Maquiladora) but aimed at the industrial development of direct and indirect exporters within domestic manufacturing (the PITEX program). Likewise, to induce the participation of small and medium enterprises in domestic manufacturing the Mexican government also devised other complementary policy instruments. Among those additional policy instruments we can mention the program to support production for exports with local content (DIMMEX), a drawback system for the reimbursement of import duties, credit loans to ensure domestic purchases from indirect exporters, additional tax incentives for high exporting firms (ALTEX), and a program devised for the support of exports by rather small domestic firms which lack capabilities to produce for exports (ECEX).

PITEX and Maquiladora became the cornerstones from Mexico's export promotion programs. Foreign and domestic firms in Mexico seeking to produce for exports could opt between those two promotion programs. Those firms that only aimed to produce for foreign markets could join the Maquiladora program, while those firms willing to produce final output both for exports and for the Mexican domestic market could join the PITEX program. Initially, firms belonging to PITEX and firms within Maquiladora faced different fiscal obligations, export-performance requirements and, different restrictions to sell output domestically. Over time, and mostly as a result of Mexico's accession to NAFTA, the rules of operation for PITEX and Maquiladora started to become more and more similar. The most important difference that still remains between those two programs is the fact that PITEX firms are mostly located in the interior of Mexico, while Maquiladora firms are mostly located in Northern states. In light of decreasing differences between the rules governing the operation of PITEX and Maquiladora firms, and given increasing competitive pressures from more efficient producers in East Asia, the Mexican government decided to merge the two export promoting programs into a major single policy framework to support exports (the IMMEX program).

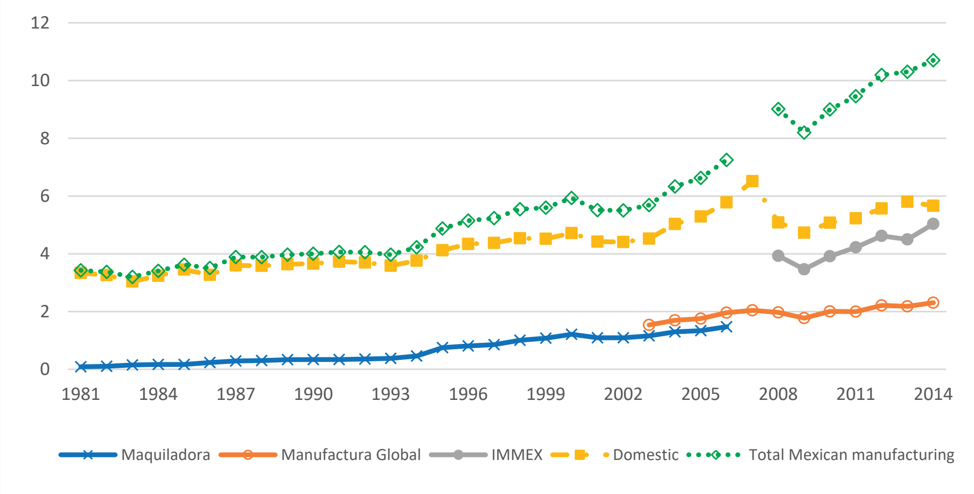
To better understand the importance and success from Mexico's production for exports, we now refer to Figure (2.1). Figure (2.1) presents the evolution of Mexican manufacturing considering gross output in Mexico, the production for exports and, the production from domestic manufacturing during the period 1981-2014. More specifically, such figure indicates total gross output in Mexico, gross output from firms within Mexican domestic manufacturing (1981-2014), the corresponding gross output for Maquiladora firms (1981-2006), as well as gross output from firms within the IMMEX program (2008-2014) [2]. Likewise, figure (2.1) also includes Mexico's new statistical attempt to measure the participation of firms located in Mexico within global production networks: the concept of Manufactura Global[3]from 2003 to 2014.

For the case of the Maquiladora program, we can observe that its share in total manufacturing output in Mexico increased from 0.2% in 1981 to 20% by 2006. We also see that the share of firms located in Mexico which are part of global production networks (as defined by the concept of Manufactura Global) follows a rather similar tendency to the one presented by Maquiladora production. According to our calculations in figure (2.1), the final output produced by Manufactura Global firms represented 21% of total final output in Mexico by 2014. Finally, the final output generated by firms within the IMMEX framework represents more than 45% of total output in Mexico by 2014. We may conclude that the production for exports in Mexico has increased from less than 1% of total output (for the firms considered within the Maquiladora framework) in 1981 to almost half of the total final output in 2014 (considering the firms in the IMMEX framework).

[2] Gross output refers to the output of consumer goods and capital goods, as well as the exports of intermediate goods. This definition of gross output is applicable for the case of total Mexican Manufacturing, domestic manufacturing, the IMMEX program, as well as the concept of Manufactura Global. For the specific case of Maquiladora, gross output only refers to the output of consumer goods and capital goods that are produced for exports.

[3] According to section 5.2.1 in chapter 5 from this dissertation, the statistical concept of Manufactura Global includes maquiladora firms and firms within domestic manufacturing highly engaged in international production networks (2003-2006). According to Mexico's statistical office, a firm highly engaged in international production networks is the one that (among other things) mostly produces for exports and that uses at least 2/3 of imported intermediate inputs in their total intermediate consumption. From 2007-2014, the same concept holds but this time they include the IMMEX firms and the firms in domestic manufacturing that meet the criteria of being highly engaged in international production networks.

Figure (2. 1): Gross Output Produced in Mexico: 1981-2014. All Manufacturing Sectors. Billions of Mexican Pesos. Constant Prices of 2010.



Source: For Maquiladora, IMMEX and Domestic manufacturing, INEGI-Banco de Información Económica (www.inegi.org.mx/sistema/BIE). For Manufactura Global, INEGI-Valor Agregado de Exportación de la Manufactura Global (VAEMG) (www.inegi.org.mx).
Notes: From 1981-2006, Total Mexican Manufacturing=Maquiladora + Domestic Manufacturing. From 2008-2014, Total Mexican Manufacturing=IMMEX +Domestic Manufacturing.

Against this background, this chapter will examine the evolution from different export promoting policies implemented in Mexico over fifty years (1965-2016) with a strong emphasis on the Maquiladora program (1965-2006), the PITEX framework (1985-2006) and the IMMEX program (2007-present). To this end, we will also separately discuss other key aspects regarding the evolution of exporting firms: location, technology, sectoral trends and so forth. Our literature review is organized as follows. Section (2.2) presents the definition of maquiladora firms as well as the different investment opportunities to participate in the export promoting program that are available for foreign exporters. Section (2.3) discusses the origin of the Maquiladora program and milestones in the evolution of this industry and of Mexican manufacturing from 1965 to the year 2006, when the Maquiladora framework officially comes to an end. Section (2.4) discusses the incentives for Maquiladora firms to locate in other Mexican regions beyond the Northern border, while section (2.5) analyzes the different attempts by the Mexican government to develop local suppliers to Maquiladora firms. Section (2.6) studies the technology available to Maquiladora firms while section (2.7) indicates the different obstacles and incentives that Maquiladora faced to sell output domestically. Section (2.8) assesses the specific context and trends in the production for exports in different manufacturing sectors. Section (2.9) is devoted to analyzing the implementation of other export promoting programs and policies that emerged with Mexico's increasing outward orientation by the mid-1980s. In this latter section, we analyze the reasoning behind the PITEX programs, the complamantary policy instruments to achieve PITEX (DIMMEX, Carta de Crédito Doméstica, etc.) as well as the implementation of smaller export promotion frameworks such as ALTEX and ECEX.

Section (2.10) thoroughly analyzes the main similarities and differences between the Maquiladora framework and the PITEX program, as well as how those differences evolved over time. Section (2.11) discusses the emergence of IMMEX program. Section (2.12) discusses Mexico's latest attempt to promote the industrialization via exports of its poorest and technologically backward Southern regions (the concept of Zonas Económicas Especiales issued in 2016). Finally, section (2.13) concludes this literature review.

2.2 Definition and Different Investment Opportunities to Participate in the Maquiladora Program.

Foreign assembly firms that participate in Mexico's export promoting program (Industria Maquiladora de Exportación) are known as maquiladora[4] firms. In the traditional concept of maquiladora production, foreign assembly firms located in Mexico import intermediate inputs and capital equipment from their parent firm located in an advanced economy. This process is facilitated by the fact that the maquiladora program offers duty free exemption on the imports of those items by foreign assembly firms. The main condition to obtain those duty-free imports is that maquila firms have to export their entire production. Drastic decreases in transportation and communications costs have made for the emergence of different ways of organizing manufacturing production that go beyond the traditional concept of maquiladora production. Thus, foreign and local firms seeking to participate in the maquiladora program face the following set of alternatives to organize and/or participate in this type of production.

The first option is that a foreign firm establishes a wholly-owned subsidiary in Mexico. This idea is close to the traditional concept of maquiladora. Here, the multinational firm decides to establish a subsidiary in Mexico to control and monopolize its productive processes (given its unique technology or highly specialized knowledge). The second option is that a foreign firm decides to implement a joint venture with other local firms in Mexico. Such strategy is common when foreign firms produce standardized goods or products at the end of their life-cycle. A third option is the shelter operation. In this type of organization, a foreign firm subcontracts a Mexican firm to do all the assembly and handle all the paper work (Wilson, 1992). Subcontracting means that the inputs and machinery sent by the foreign entity are not owned by the Mexican firm. A Mexican firm participating in this shelter operation is entitled to work with many different foreign clients. Similarly, Mexican firms producing for the domestic market can also pursue shelter operations by relying on their idle capacity. Shelter operations with local firms in Mexico are also an interesting option for small foreign firms that do not wish to run the risk of investing in their own Mexican maquiladora firm (Wilson, 1992).

[4] According to Angulo Parra (1998), the word "maquila" originally meant "wheat" in very old Spanish. A miller could convert a farmer's wheat into flour. As a payment, the miller could ask for some of portion of the wheat that was turned into flour. The portion of the wheat (maquila) that was milled and kept by the millers was then known as maquiladora. As time passed, the words "maquila" and "maquiladora" acquired an industrial sense and, now refer to a Mexican custom law regime regulated through customs decrees.

2.3 Origins of the Maquiladora Program and General Events in the Evolution of this Industry (1965-2006).

The maquiladora industry was devised as a regional strategy for the industrial development of Northern Mexico by the mid-1960s (Wilson, 1992; Skliar, 1993). There are two main reasons that explain the origin of this industry and its initial regional character. The first one is the end of the bracero guest program in the US. During the Second World War, a great number of low-skilled Mexican workers were invited to join the US work force. When this bracero program ended, many Mexican workers returned to their country and stayed in the border region causing large unemployment. The maquiladora export promoting program was then devised as an alternative to cope with rising unemployment in Mexico's northern border region. Attracting foreign firms to benefit from Mexico's cheap labor was one of the main initial ideas behind this program.

The second reason for the emergence of the maquiladora industry in northern Mexico was the implementation of new trade policies in the US by the early 1960s. US intermediate inputs falling under the categories 806.30 and 807.00 of the US tariff schedule could be imported back to the US free of duty, if they had been assembled abroad as final or intermediate manufacturing good. Item 806.30, issued in 1956, refers to metal articles while item 807.30, issued in 1963, refers to fabricated components (Skliar 1993; CEPAL, 1996). Reimporting those items back to the US as final or intermediate goods would only imply paying US customs duties on foreign value added other than assembly. In this context, the combination of high endowments of cheap labor, the unique proximity to the US market and, preferential treatment under Mexican and US trade policies made the maquiladora strategy a feasible alternative for foreign firms seeking to reallocate production to low cost countries.

To better understand the impact of historical events in maquiladora, we will analyze the evolution of this industry in different periods. The first period is that of the restrictive framework imposed on maquiladora firms since its inception until the early 1980s. The second period covers the process by which maquiladora firms became one of the cornerstones of Mexico's increasing outward orientation (1982-2000). The last period will highlight the first important contraction in the output of this industry as a result of the emergence of more efficient low cost producers in East Asia.

2.3.1 Restrictive Framework for Maquiladora Firms: (1965-1981).

During this initial period, there were no official attempts to promote the technological development of maquiladora firms. The main reason for this was the fact that the maquiladora program was not in line with the Import Substitution Industrialization (ISI) policies prevailing in Mexico at that time. Providing tariff exemptions to manufacturing firms with foreign capital engaged in the maquiladora program was simply a policy contrary to the strategy of ISI. Apart from Mexico's deep commitment to ISI, other reason for the restrictive policy framework was that the Mexican government did not want any interaction or competition between domestic and maquiladora firms (which mostly operated under the traditional concept of foreign subsidiary). For instance, in line with the regulations from Mexican general Law on Foreign Investment in 1973, the government could review and control the implementation of technologies in maquiladoras. Also, the government was able to prohibit any foreign firm from entry if it could harm domestic industry (González, 1990). In the view of Mexican policy makers, the maquiladora program was only designed to be a temporary strategy to alleviate rising unemployment and to earn foreign currency. Mexico's engine of industrial growth was expected to be found in domestic manufacturing further supported by a booming oil industry during the 1970s.

Such lack of interaction between maquiladora and domestic manufacturing also prevented increasing local sourcing in the production for maquiladora exports. Nevertheless, foreign firms in the maquiladora program also had very little incentives to source inputs locally. This was because of the tariff penalization on the use of non-US inputs under the items 806 and 807. The US's accession to the Generalized System of Preferences (GSP) by 1976 also prevented maquiladora firms from greater local purchases of domestic inputs. Under this system, industrialized countries gave preferential treatment to the manufacturing exports from developing countries. Selected articles by the GSP were chosen provided that some conditions were met. For the case of Maquiladora, at most 35% of the value of the goods had to be added in Mexico. The cost of labor, as well as the cost of domestically manufactured inputs, fuels and electricity could be counted in the 35% (Schwartz, 1987).

2.3.2 Currency Crises, Mexico's Increasing Outward Orientation and Booming Maquiladora Production: (1982-2000).

By 1982, Mexico's debt and currency crises drastically altered its inward looking industrial development strategy. From this year onwards, Mexico formally abandoned the ISI strategy in favor of a more outward orientation. It is in this context, that maquiladora production experiences its first major policy shift by 1983. It moved from being a temporary program and an anomaly in the prevailing ISI, to be one of the key factors in the export oriented strategy of the Mexican government. According to Wilson (1992), with the devaluation of Mexican peso (which made Maquiladoras wages more attractive than Asian wages) and official encouragement, the Maquiladora industry boomed by the end of the 1980s to become one of the largest sources of foreign exchange in Mexico, after petroleum exports and before tourism.

During this second period, other important policy shifts were also observed. In 1985, Mexico joined the General Agreement on Tariffs and Trade (GATT). Such accession served as an additional push for the set of domestic and international trade reforms to be implemented in the subsequent years. By 1989, the government set additional objectives for the evolution of maquiladora production. Not only were maquiladora firms encouraged to meet its traditional objectives (higher export levels, employment, foreign investment and foreign exchange). More importantly, this industry was now seen as a tool that would stimulate technological development and that would promote investment in human capital in Mexico. All these objectives were to be realised through increasing interaction between maquiladora and domestic manufacturing firms (Government of Mexico, 1989). In few years, the Mexican government switched from blocking any kind of interaction between foreign assembly and domestic firms, to increasingly promoting a framework where both types of firms could equally develop.

The government also implemented more incentives for the development of other types of maquiladora firms (beyond the traditional concept) and for an increasing use of domestic inputs. For instance, a maquiladora decree (issued in 1989) extended duty-free status to service companies and subcontractors of maquiladora firms. The same decree authorized 100% exemption from the value added tax to local firms supplying inputs to maquiladora.

A key policy change for Mexico occurred in 1994 when the country joined the US and Canada in the North American Free Trade Agreement (NAFTA). NAFTA ended the special tariff treatment for US firms offshoring to Mexico under tariff items HS902, i.e. the items formerly known as 806.30 and 807.00 (Feenstra et al., 2000). Nevertheless, this change did not slow the growth of production in maquiladora firms (Bergin et al., 2009). The main reason for this is that the implementation of NAFTA not only implied the removal of trade tariffs, but also of investment barriers. Likewise, NAFTA further increased the preferential access of maquiladora firms to the US market due to the execution of the principles of national treatment and of most-favoured-nation (NAFTA Article 102). National treatment for goods means that once goods have been imported into any NAFTA member country, they will not be subject to tariff discrimination. On the other hand, most-favoured-nation treatment implied that the signatories of NAFTA have to extend trading benefits to each other equal to those accorded to any (that is, the most favoured) non-NAFTA country (Javorcik et al., 2008). In this context, non-NAFTA originated inputs had to pay Mexico's Most Favored Nation (MFN) tax, of around 35%, while the intermediate goods originating in the NAFTA region could be imported free of duty. This whole new regulation created an important incentive for the production of parts and components in maquiladora because the inputs eligible for the tariff exemption could not only be those produced by a NAFTA country, but also those inputs produced by other regions that have been previously processed in Mexico and that include some degree of NAFTA content.

Just as in 1982, the major policy shift implemented in 1994 coincided with a major currency devaluation. Mexico's balance of payment crisis at the end of 1994 and, the subsequent Tequila crisis, implied yet another incentive for multinational firms to participate in the maquiladora porgram. This is because the highly devaluated peso made manufacturing production in Mexico cheaper (i.e. domestic inputs and wages). In this context, the combination of trade policies within NAFTA and the highly devalued Mexican currency explain the boom in maquiladora production by the end of the 1990s.

In order to better understand maquiladora's booming production by the late 1990s, let us refer to the following example by Angulo Parra (1998). In line with Mexico's legal framework, a Maquiladora firm can temporary import intermediate and capital goods to be used in their production for export, free of all duties and value added taxes. This means that a maquiladora firm can import from Taiwan, Singapore, Malaysia or any other place in the world any component it needed for producing a final good for exports without paying import duties. If this maquiladora used sufficient intermediate goods from the US, Canada or Mexico to meet NAFTA rules of origin, its output could be considered of NAFTA origin and, thus, it could also enter the US market free of duty. In this perspective, with zero tariffs, firms participating in maquiladora production could face no duties on their imports of intermediates (from East Asia) and exports of final output to the USA.

2.3.3 A NAFTA Framework for non-NAFTA countries, Industrial Emergence of China and, Drastic Contraction in Maquiladora Output (2001-2006).

Maquiladora's production boom ended during the early 2000s as result of new obligations imposed by NAFTA on its country members, the industrial emergence of major low cost producers (China's accession to the World Trade Organization) and, the 2001 US crisis.

According to NAFTA article 303, as of 2001 only North American inputs were going to be exempted from import tariffs upon entering one of the signatory countries. Non-NAFTA inputs would then be required to pay custom duties when imported. These new NAFTA regulations implied a negative scenario for maquiladora production. As mentioned before, the maquiladora legal framework had allowed for the free imports of intermediate and capital goods from anywhere in the world. This represented an important incentive for the participation of maquiladora firms in international production networks reaching beyond North America. For instance, think of the previous maquiladora example by Angulo Parra (1998). In line with the new regulations that were to be effective as of 2001, the same maquiladora firm would need to pay custom duties on their imports from Taiwan, Singapore or Malaysia, when producing a good to be exported to the US market. In particular, this was the case for firms in the electronics sector that mostly rely on the intermediate goods produced by efficient East Asian production networks. Tariff exemptions were only available if maquiladora firms used a pre-determined amount of North American inputs.

Historically, maquiladora production mostly consisted of foreign assembly firms in the electronics sector. Many of them found the new NAFTA regulations detrimental to their competitiveness. China's accession to the World Trade Organization (WTO), also scheduled to take place in 2001, represented a serious reallocation alternative for electronics maquiladoras operating in Mexico. Reallocating production from Mexico to China would allow those maquiladora firms to take advantage of even cheaper labor and of a more well defined network of suppliers than the ones available in a Mexico. If paying duties when entering the NAFTA market was unavoidable, they would prefer to pay duties when sending final goods all the way from the China to the US, rather than paying for the different intermediate goods sent to Mexico.

Under this dramatic scenario for the maquiladora industry, policy makers in Mexico issued a new legal framework in 2002 named "Programas de Promoción Sectorial" (PROSECs) or sectorial promotion programs. The main objective behind the PROSECs was to adjust the maquiladora program to the new NAFTA regulations and to prevent foreign firms within such industry from leaving the country. In order to design PROSECs, policy makers in Mexico identified those key intermediates inputs and capital goods that were more commonly imported by maquiladora firms in different manufacturing sectors. Those intermediate and capital goods identified under the PROSEC list (that were usually imported from non-NAFTA countries) could be eligible for zero (or a maximum of 5%) custom duties upon entering Mexico (Gantz, 2004). Those firms using non-NAFTA inputs that were not included within the PROSECs list could request for tariff exemptions under the program known as "Regla Octava" (Dutrenit et al., 2006). Both PROSECs and Regla Octava applied to all manufacturing firms in Mexico (maquiladora and domestic manufacturing) and required previous authorization by the Ministry of Economics.

In the view of Dussels Peter and Katz (2006), the implementation of PROSECS implied the creation of a framework under which non-NAFTA countries could benefit from NAFTA. With PROSECs, the Mexican government was not only expecting to alleviate the possible threat of maquiladora firms leaving the country and thus reducing output, employment, foreign exchange and foreign investment for the economy. More importantly, PROSECs and Regla Octava would also enable the participation of Mexico within international production networks beyond the North American region.

Nonetheless, imposing duties on the use of non-NAFTA inputs had the precise objective of strengthening the North American region and protecting it from external competitors. It also represented an important opportunity for maquiladora firms to start using more US, Canadian and local inputs. Acknowledging the fact that the maquiladora mostly consists of foreign firms within the electronic sector that primarily rely on East Asian intermediate inputs, policy makers in Mexico opted for alternatives that would preserve the strategic position and competitiveness of maquiladora firms within international production networks. In this context, it can be argued that by implementing PROSECs Mexico was not only abandoning its right to tax non-NAFTA inputs within the NAFTA framework. It was also further supporting the production for export with high use of foreign inputs at the expense of local suppliers.

Notwithstanding all these changes implemented by the Mexican government, the industrial emergence of China by 2001 had a profound negative effect on maquiladoras (Sargent and Mathews, 2009). One of the main reasons for such a negative effect can be found in the similarity of the composition of US imports from Chinese and Mexican producers (Dussel Peters, 2005; Gallagher et al., 2008). Similarly, as mentioned already, reallocating production from Mexico to China ended up being a feasible alternative for many maquiladora firms that were seeking to produce under conditions not offered by Mexico (cheaper labor, better access to more technologically developed suppliers, and so forth). Those two factors, along with the 2001 US crisis largely contributed to the first major contraction in the history of the maquiladora program. In October 2000, 3,655 maquiladoras employed 1,347,803 people. By December 2003, the number of plants and employees had fallen to 2,802 and 1,050,201, respectively (a net loss of 853 maquilas and 297,602 jobs) (Sargent and Mathews, 2009). As of October 2006, maquila employment was still below the peak reached in 2000.

2.4 Beyond the Border: the Location of Maquiladora Firms in Other Mexican Regions.

Historically, Maquiladora firms have located in northern Mexico (right next to the border with the US). According to table (2.1), more than 80% of all maquiladora firms in Mexico were located in Northern Mexico between 1990 and 2006. Nevertheless, as will be seen in the next paragraphs, from the very beginning of the maquiladora program, the government in Mexico has also implemented several incentives for these firms to locate elsewhere in the country.

Table (2. 1): Location of Maquiladora firms in Mexican Regions: 1990-2006
Number of Maquiladora Firms

Year	Northern Mexico	Central Mexico	Western Mexico	Southern Mexico	Other Regions	Total Mexico
1990	1,658	23	44	16	48	1,789
1991	1,835	29	50	25	74	2,013
1992	1,938	26	36	30	99	2,129
1993	1,921	29	44	25	124	2,143
1994	1,827	31	49	31	126	2,064
1995	1,955	47	56	37	172	2,267
1996	2,172	192	59	42	88	2,553
1997	2,428	224	71	55	89	2,867
1998	2,569	296	86	74	105	3,130
1999	2,761	390	98	106	81	3,436
2000	2,962	419	113	131	78	3,703
2001	2,623	336	124	122	74	3,279
2002	2,393	291	127	89	76	2,976
2003	2,266	263	113	90	70	2,802
2004	2,307	240	96	89	76	2,808
2005	2,330	229	93	76	84	2,812
2006	2,324	209	97	74	79	2,783

Source: INEGI, Banco de Información Económica (www.inegi.org.mx/sistemas/bie).
Northern Mexico: Baja California, Baja California Sur, Coahuila, Chihuahua, Durango, Nuevo León, Sinaloa, Sonora, Tamaulipas.
Central Mexico: Guanajuato, Estado de México, Distrito Federal, Puebla, Querétaro, San Luis Potosí.
Western Mexico: Jalisco
Southern Regions: Yucatán

Unique access to the US market, better infrastructure in such country as well proximity to major industrial centers in southern US are the main reason for maquiladora firms to mostly locate in Mexico's border region. At the beginning of the maquiladora program, the foreign assembly firms that established in northern Mexico were those US firms that could not afford reallocating production to East Asia (small firms and firms with low value to weight ratio) as well as those large multinationals that wanted to spread their country risk by locating additional plants outside Asia (Wilson, 1992). In 1966, those maquiladora firms were only allowed to stay within 20 kms of the Mexican border. The initially temporary nature of the maquiladora program, the fact that it was designed to alleviate rising unemployment in northern Mexico and the prevailing ISI strategy account for this issue.

By 1972, the Mexican government allowed maquiladora firms to be located anywhere in Mexico (Urias, 1978; CEPAL, 1996). The main idea behind this policy change was that the income generated by maquiladoras located in the interior of Mexico could also be used to purchase domestic manufacturing goods. Nevertheless, maquiladora firms were still subject to strict regulations restricting competition or interaction with domestic manufacturing firms. This changed when Mexico abandoned the ISI strategy. By 1983, the government wanted more and more maquiladoras to locate in the interior of Mexico. According to the 1983 maquiladora decree, maquiladora firms that established themselves in the underdeveloped interior of Mexico (Southern Mexico) would be allowed to sell up to 40% of their output domestically. Maquiladoras located elsewhere could only sell up to 20% of the production domestically (Wilson, 1992).

Increasing regional income and reducing unemployment in the interior of Mexico were not the main reasons for maquiladora firms to locate beyond the border region. This time, policy makers had realized that non-border maquiladoras consistently used more domestic inputs in their production for exports than border maquiladoras (Wilson, 1992; Branon et al., 1994). According to table (2.2), such a situation still exists in 2006 and, even in 2016 considering firms operating within the IMMEX program (see table 2.5 at section 2.11). The top panel in table (2.2) shows the share of domestic intermediates in total intermediate consumption for maquiladora firms located in Northern states from 1990-2006. The bottom panel from table (2.2) shows the same share but focuses on maquiladora firms located in other Mexican regions different from the Northern area. As the reader might notice, most of the Northern- Mexican states located right next to the US border (Baja California, Sonora, Chihuahua, Coahuila, Nuevo León, Tamaulipas) use less than 2% of domestic inputs in their total intermediate consumption. One of the main reason for such small domestic intermediate consumption from maquiladora firms in border states is related to the organization of international production networks within the electronics sectors. According to Contreras and Evans (2003), by 2000 the Television industry in Northern Mexico employed more than 90,000 workers (of which 10,000 were technicians and engineers) and produced 30 million units a year (representing 90% of the total production in the North American region). The TV industry (and the electronic maquiladora industry in general) mostly relies on imported intermediate goods to produce final goods and thus, the maquiladora firms in the border region rely on a limited amount of domestic inputs.

On the other hand, in the rest of Mexican states with maquiladora production, we observe (in the bottom panel of table 2.2) that Guanajuato and Distrito Federal (i.e. Mexico City) show the highest consumption of domestic intermediate goods. In line with Ortiz and Martínez (2000), those two states, along with Jalisco, account for more than 90% of the total domestic production of footwear. Maquiladora firms located in those latter states mostly rely on the domestic inputs provided by domestic firms in the same region. As the reader might notice, this higher use of domestic inputs is unusual for maquiladora firms, but not for domestic manufacturing firms. Such higher use of domestic inputs for maquiladora firms located in the interior of Mexico was not the result of multinational firms investing in local technological capabilities. Rather, it was the result of domestic firms seeking to survive Mexico’s outward orientation via maquiladora status. When non-border local firms acquired maquiladora status, they started producing for exports by relying on their own network of domestic suppliers. In contrast, foreign owned and initiated maquiladoras located in the border region continued to rely almost exclusively on foreign inputs (Wilson, 1992).

Table (2. 2): Share of Domestic Intermediate Consumption in Total Intermediate Consumption for Maquiladora (All Manufacturing Sectors in Mexican regions): 1990-2006

Year	Northern Mexico									Total Mexico
	Baja California	Baja California Sur	Coahuila	Chihuahua	Durango	Nuevo León	Sonora	Tamaulipas	Sinaloa	
1990	1.1	1.9	1.7	0.9	0.6	9.3	0.5	1.2	-	11.0
1991	1.1	0.5	1.6	1.0	0.4	7.1	0.2	0.9	-	11.4
1992	1.2	0.2	1.9	0.9	0.6	8.7	0.3	0.9	-	10.8
1993	1.2	0.7	2.7	0.9	0.9	5.8	0.2	1.1	-	10.2
1994	1.1	0.1	2.2	0.8	1.1	4.8	0.4	0.8	-	8.8
1995	1.1	0.1	3.7	0.9	1.6	4.3	0.5	1.1	-	6.5
1996	1.2	0.0	3.4	1.2	3.6	5.2	0.7	1.1	-	8.2
1997	1.2	0.1	2.8	1.6	4.6	5.3	0.6	1.2	82.3	9.1
1998	2.3	0.4	3.6	1.1	5.0	5.7	1.6	1.2	92.2	9.3
1999	2.3	0.0	3.7	1.2	6.8	7.3	1.2	1.2	79.6	10.0
2000	1.7	0.5	4.1	1.3	10.7	7.1	0.9	1.2	70.0	11.0
2001	1.4	0.9	3.6	1.8	9.0	7.0	0.5	1.6	68.0	12.6
2002	1.5	1.1	3.3	3.1	8.5	7.6	0.8	1.8	27.9	12.5
2003	1.7	0.0	2.4	2.6	2.4	7.5	0.7	1.2	4.5	12.9
2004	1.3	0.0	2.4	2.3	3.4	7.0	0.5	1.0	2.7	11.7
2005	1.1	0.0	2.8	2.3	3.3	9.0	0.6	1.3	0.6	12.0
2006	1.1	0.0	3.5	2.7	5.1	9.4	1.0	1.3	0.9	12.2

Year	Central Mexico							Southern Mexico	Western Mexico	Other Mexican Regions
	Aguascalientes	Guanajuato	Distrito Federal	Estado de México	Puebla	San Luis Potosí	Zacatecas	Yucatán	Jalisco	
1990	-	-	-	-	-	-	-	0.5	6.7	23.5
1991	-	-	-	-	-	-	-	2.5	9.4	25.5
1992	-	-	-	-	-	-	-	2.0	8.4	28.8
1993	-	-	-	-	-	-	-	1.0	12.8	20.7
1994	-	-	-	-	-	-	-	1.6	13.2	15.3
1995	-	-	-	-	-	-	-	1.2	11.4	13.7
1996	6.4	21.1	-	-	33.6	-	-	2.7	5.6	9.7
1997	7.5	25.0	41.0	23.3	38.3	-	-	3.6	5.2	9.4
1998	6.9	25.8	38.5	36.4	32.4	-	-	4.5	2.6	8.0
1999	6.9	23.1	9.9	40.2	23.5	22.2	4.2	6.1	7.0	13.2
2000	10.3	25.8	7.4	43.5	22.4	31.6	2.3	7.5	6.8	16.2
2001	8.6	30.2	19.5	57.5	17.3	31.4	1.3	5.9	7.2	14.1
2002	3.9	27.2	15.6	51.8	19.5	30.2	1.5	3.3	4.8	13.1
2003	4.2	29.0	18.4	31.4	21.9	28.7	2.1	2.9	6.6	7.3
2004	4.3	34.0	34.9	28.3	14.6	27.4	1.7	2.8	9.9	9.7
2005	6.8	37.9	63.0	21.6	17.4	24.2	2.6	2.8	8.5	12.6
2006	8.7	36.2	9.4	14.1	22.0	22.1	2.9	3.7	8.2	9.6

Source: INEGI, Banco de Información Económica (www.inegi.org.mx/sistemas/bie).

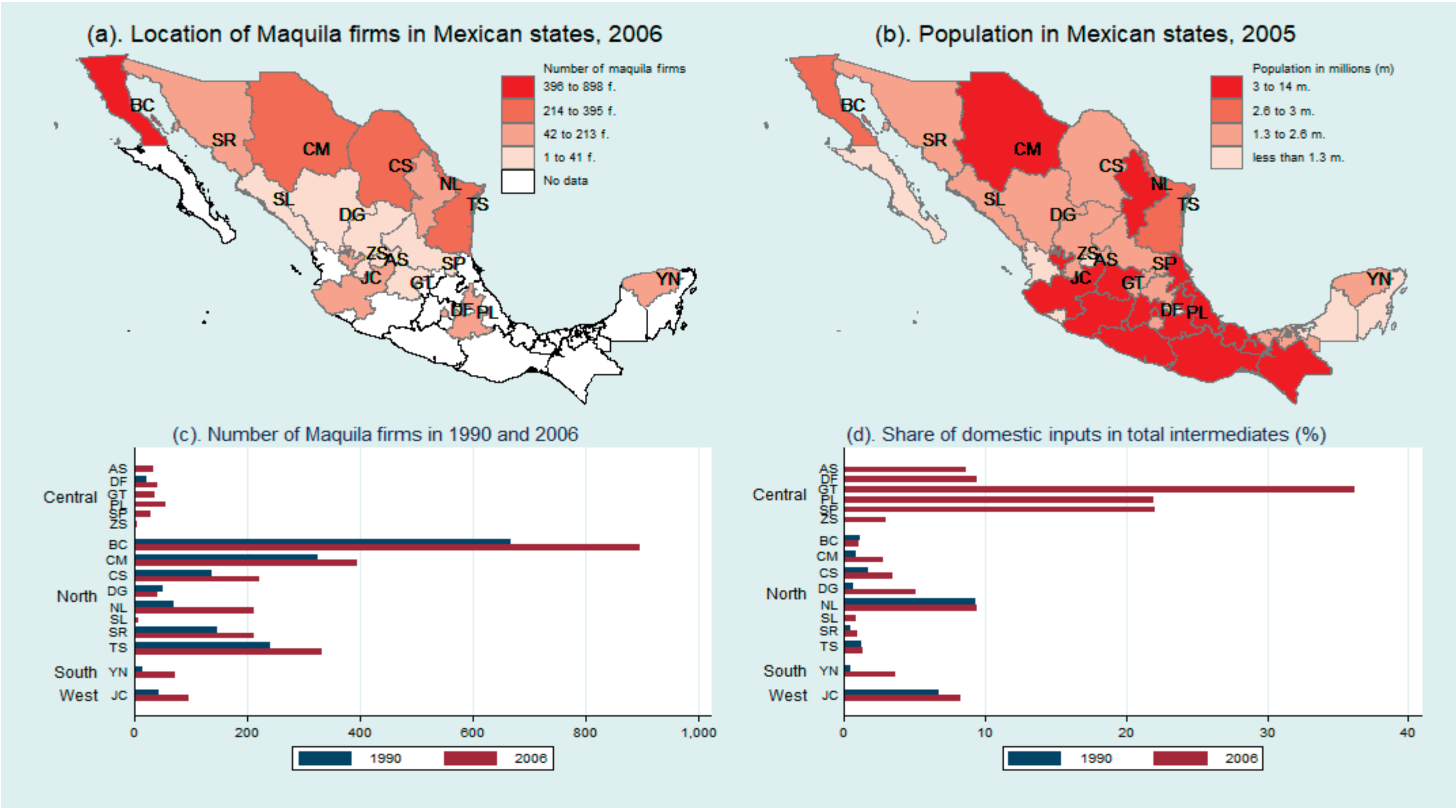
Some of the characteristics of non-border regions are also attractive for foreign assembly firms. Labor is more stable in the interior of Mexico when compared to the turnover rates in border towns. Likewise, qualified labor is more abundant in Central Mexico than in the northern region. There is higher availability of certain inputs in the interior (wood in Guadalajara, steel from Monterrey), as well as the proximity to a major final market such as Mexico City. Finally, it is worth mentioning that maquiladora firms in the interior of Mexico were also seen as a tool to stop migratory flows of low-qualified Mexicans to the US.

In order to further understand the location of maquiladora firms in different geographical regions across Mexico, we refer to the information presented in figure (2.2). Figure (2.2) is divided into 4 charts. Chart (a) contains a map with the location by 2006 of maquiladora firms according to Mexican states. Chart (b) indicates the distribution of population by Mexican states in 2005. Chart (c) presents the number of maquila firms in 1990 and 2006, while chart (d) indicates the share of domestic intermediates in total intermediate consumption. Both chart (c) and (d) present information according to Mexican state and major geographical region in Mexico.

On the one hand, by comparing chart (a) and (b) we can observe that the vast majority of maquiladora firms were not located in Mexico's most populated regions by 2006. For instance, the Mexican states with population levels between 3 and 14 million people and that are colored in red in chart (b), (i.e. the heavily populated states) have a very limited or non-existent presence of maquiladora firms (the states that are left in blank in chart a). Furthermore, as will be discussed in section 2.11, this situation is still present by 2016 in the context of the IMMEX firms[5]. On the other hand, chart (c) further confirms that the distribution of maquiladora firms in Central, Southern and Western Mexico has remained basically unaltered since 1990. Likewise, chart (d) also confirms that those areas with a lower presence of maquila firms (and that are heavily populated) consume far more domestic inputs than firms located in Northern Mexico.

[5] Section 2.12 is devoted to explaining the main reasons as to why maquiladora firms have historically been mostly located in Mexico's northern regions. In addition, the latter section also describes Mexico's current policy response to induce the location of more exporting firms in the Southern region (i.e. the project known as Zonas Económicas Especiales).

Figure (2. 2): Different Regional Dimensions of Maquiladora firms, 1990 and 2006.



Source: Author's calculation. For (a), (c) and (d), INEGI, Banco de Información Económica (www.inegi.org.mx/sistemas/bie). For (b), INEGI Conteo Nacional de Población y Vivienda, 2005.

Notes: AS: Aguascalientes; **DF**: Distrito Federal; **GT**: Guanajuato; **PL**: Puebla; **SP**: San Luis Potosí; **ZS**: Zacatecas; **BC**: Baja California; **CM**: Chihuahua; **CS**: Coahuila; **DG**: Durango; **NL**: Nuevo León; **SL**: Sinaloa; **SR**: Sonora; **TS**: Tamaulipas; **YN**: Yucatán; **JC**: Jalisco.

2.5 The Development of Local Suppliers to Maquiladora Firms.

Yet another concern of the Mexican government has been the promotion and technological development of local local firms acting as suppliers to the maquiladora industry. There are two types of such local suppliers. On the one hand, there are the local suppliers that start operations in Mexico as a result of a maquiladora firm being establishing in this country. Those local suppliers belong to a multinational firm and their objective is to produce intermediate inputs in Mexico that are complementary for the final stage of manufacturing. According to Wilson (1992), local suppliers produce productive and non-productive inputs for maquiladora firms and provide different types of services. For instance, for the key maquiladora sector (electronics) local productive inputs include industrial gases, metal chassises, varnish, wire screws, tools and so forth. Non-productive inputs include packaging materials such as cartons, dry ice, Styrofoam, rubber boots and uniforms for workers. Services include the hiring of labor, repairing machinery and equipment, and so forth.

The second type of local suppliers are those firms belonging to the domestic manufacturing of Mexico. These firms are producing for the domestic market and seek to participate in the maquiladora program as indirect exporters, since they cannot afford to or do not want to become a maquiladora firm. Unlike the first type of local suppliers, this second group of firms does not belong to multinational firms and thus, they face a great number of problems when trying to sell their inputs to maquiladora firms. Poor product quality, high prices, long delivery processes, lack of knowledge about Mexican suppliers, unavailability of specific Mexican inputs, long standing procurement relationships with other foreign firms and lack of purchasing authority by the maquiladora firm are only some of main problems faced by local suppliers (Brannon et al., 1994). Another important factor that explains the problems faced by local suppliers is the fact that foreign assembly firms reallocate production to Mexico already knowing and relying on their own network of suppliers. Similarly, maquiladora firms benefit from the proximity to competitive suppliers that are not located in Mexico, but in the US. Therefore, maquiladora firms have very little incentive to looking for additional suppliers when setting up operations in Mexico. More importantly, they are also not willing to invest in the technological development of local suppliers in Mexico, as the maquiladora program provides all the necessary means to import foreign intermediate inputs from anywhere in the world at zero tariffs. In this context, the only valid alternative for this second group of local suppliers is to mostly supply maquiladora firms with non-productive inputs and complementary services or provide the less technologically complex productive inputs.

Only limited attempts have been made to promote the integration of local suppliers into the production of maquiladora firms. As mentioned before, in 1989 local suppliers were granted maquiladora status and were also exempted from value added taxes. Similarly, in 2000 the government implemented a program for the development of these kind of producers (Dussel Peters, 2000). Nonetheless, despite these attempts, most maquiladora firms have not modified their high consumption of foreign intermediates.

2.6 Technology: Four Generations of Maquiladora Firms.

During the 1960's and 1970's, rather harsh regulations were imposed to prevent the technological development of the foreign assembly firms participating in the maquiladora program. For instance, in line the 1973 Law on Foreign Investment, the Mexican government was entitled to review and control the use of technology for maquiladora firms. Furthermore, it could forbid the entry of any foreign firm that could harm the national industry (González, 1990).

It was not until the early 1980s that this restrictive framework was modified. In the course of this decade, more use of technology and higher decision making were observed in automotive and electronic maquiladoras (Wilson, 1992; Carrillo and Hualde, 1997). Despite these changes, activities in most maquiladora firms remained monotonous and were still limited to assembly. On the one hand, more technology was introduced in order not to increase local capabilities. Rather, it was introduced to obtain more precision, control and quality in maquiladoras' labor intensive activities. This implies that, in most of the cases, the old machinery was replaced by technologically more sophisticated instruments that still only needed a low qualified workforce to operate them (Carrilo and Hualde, 1997). On the other hand, regarding higher levels of autonomous decision making, it can be argued that this remained restricted to recruitment and human resource management (Carrillo and Hualde, 1997). Hardly ever did local managers participate in the selection of inputs or in the decision process of the manufactured goods to be produced as most of the technical specifications came from abroad. Along the same lines, local management had little influence, if any, on investment, finance or production technology decisions (Wilson, 1992).

According to Carrillo (2007), a shift from labor intensive activities to more complex technological procedures was observed in some maquiladora firms as a result of the boom in production during the mid-1990s and due to new regulations that reduced uncertainty and allowed for long-term planning operations (1990's Law on Foreign Investment). In line with Buitelaar and Padilla (2000), modern management systems were commonly seen in foreign assembly firms. Total quality control, just-in-time procedures, operation manuals as well as norms regarding organizational culture and labor discipline were some of those management systems observed in maquiladoras. The presence of more qualified labor and of more research and development (R&D) departments was also documented by the mid-1990s.

China's increasing presence in global markets represented yet another incentive to promote the technological development within maquiladoras. During the early 2000s, the Mexican government provided tax incentives to maquiladora firms engaged in R&D and created a fund to promote Mexico's software industry (Ruiz Durán et al., 2005). State governments, industry chambers, and universities were also involved in the upgrading efforts. The branch of Mexico's largest private university system in Guadalajara established institutes designed to accelerate the development of design engineering centers, software development firms, and technology intensive startups in the city's cluster of electronics firms. The government in Mexico was especially interested in attracting new companies engaged in applied research, product and process development, product testing, and high-tech manufacturing in five industries;

biotechnology, mechatronics, information technology, health, and nanotechnology (Sargent and Mathews, 2008).

Understanding the previously described technological trajectory of maquiladora firms has been a prime concern for Mexican scholars. They have categorized maquiladora firms into four generations that differ in terms of their observed technology levels. Such categorization goes from those maquiladoras operating with low levels of technology (first generation) to those relying on high and complex technological and organizational procedures (fourth generation).

The first generation of maquiladoras (Brown & Dominguez, 1989) mainly performed activities which required few skills and a low level of technology (assembly activities). In general, these maquiladoras appeared in the 1960s and were the dominant type of firm in the maquiladora industry until the mid-1980s (Carrillo & Hualde, 1997). These firms were more interested in the volume of output than in the quality of production. Moreover, this first generation of firms only took advantage of the immediate benefits offered by the maquiladora program (tariff exemptions, cheap labor and geographical proximity) without any further incentive to develope technological capabilities in Mexico. Foreign managers are mostly observed in these first-generation of maquiladora firms (Dutrenit & Vera-Cruz, 2002).

Second-generation maquiladoras possess some degree of autonomy with respect to the headquarters and also apply more sophisticated organizational procedures than the first generation of maquiladoras. These firms produce with higher quality standards, rely on more qualified labor and are concerned about improving delivery times. According to Carrillo & Hualde, (1997), these second generation of maquiladoras mainly appeared from the mid-1980s until 1994 when the NAFTA agreement was signed. Maquiladoras of third generation are characterized by R&D activities which require highly qualified labor. This third generation of maquiladora firms has incentives to develop direct and indirect suppliers of intermediate inputs in Mexico (Carrillo & Hualde, 2002). Higher quality and lower production costs are the main source of competitiveness for these firms. Such type of maquila firms mostly appear after the implementation of NAFTA. More Mexican managers in strategic positions is another important feature of this third generation of maquiladora firms (Dutrenit & Vera-Cruz, 2002).

Firms that establish themselves in Mexico to coordinate activities of different subsidiaries belong to the fourth generation of maquiladoras. These maquiladora firms perform activities that are similar to those of the firm headquarters. They perform R&D activities, coordinate direct and indirect exporters and supervise assembly in order to ensure the timely delivery of final manufacturing goods. One important feature is that these maquiladoras of the fourth generation mostly belong to the regional production network within the NAFTA region (Carrillo & Lara, 2004). These firms based their competitiveness on logistics and on the correct synchronization of activities of the firms within the production network (Lung, 2004).

As can be seen, the emergence of different generations of maquiladoras coincides with different strategies to organize manufacturing production and with changes in Mexico's trade policies over time (Carrillo & Lara, 2004). Different generations of maquiladora firms are also the result of technological innovations and of drastic reductions in transportation and communication costs. One important thing to keep in mind is that those four generations of maquiladora firms coexist with one and other. This means that the existence of one generation of maquiladora does not eliminate the other one (Contreras and Munguia, 2007). It also highlights the fact that very few maquiladora firms have actually been able to achieve a proper transition from one generation to other. Differences in the level of technology required per manufacturing sector as well as lack of incentives from multinational firms in the largest maquiladora sector (electronics) to help in the upgrading efforts account for this issue.

2.7 Domestic Sales of Maquiladora Output

Over time, firms in the maquiladora industry have faced different restrictions to sell their final output domestically. Those restrictions have varied over time and by 2001 they had been dropped. Foreign markets, however, are still the main destination for maquiladora's final output and this tendency has remained basically unaltered over time.

Domestic sales of maquiladora final output were initially regarded by the Mexican government as purchases of imported goods. With the implementation of the maquiladora program in 1965 those imports were initially forbidden. By 1972, maquiladora firms were allowed to sell domestically provided that their goods did not compete with domestic manufactured goods (substitute imports) and the firms payed the required taxes. Import licenses and taxes on the use of imported goods were also imposed on those domestic sales by 1977 (CEPAL, 1996).

Additional restrictions were issued on the domestic sales of maquiladora output given the opening of the Mexican economy by the early 1980s. Policy makers in Mexico feared that an open domestic market could result in the entry of a great number of imports and of maquiladora output, thus wiping out inefficient local producers. According to the maquiladora decree of 1983, only up to 20% of their output could be sold in the local market under the condition of using at least 15% of domestic inputs (Carrillo & Hualde, 1997).

By 1989, the permission to sell domestically was increased to 50% of total output (CEPAL, 1996). Promoting higher final output within the maquiladora industry was not the main reason for such increasing allowance to sell domestically. More importantly, the Mexican government was creating the environment for the successful integration of maquiladora firms with other firms in North America. The signing of NAFTA required Mexico to eliminate the non-tariff barriers imposed on the maquiladora firms. Restricting Maquiladoras to sell only a portion of their output domestically was considered as a non-tariff barrier. Henceforth, as of 1994, maquiladora firms could sell up to 55% of their production locally. Furthermore, this percentage was scheduled to increase by 5% every year until 2001, when 100% of maquila output could be sold domestically (CEPAL, 1996).

Despite the continuous removal of restrictions, maquiladora firms have also showed little willingness to sell their output in the Mexican market. According to Carrillo &

Hualde (1997) and Barajas et al. (2003), in 1988 only 15 maquiladoras obtained a permission to sell output domestically. Although information for domestic sales is not reported in the published statistics, Mexico's statistical office has carried out unpublished surveys, and has consistently found that maquiladoras sell less than 5% of their output in the domestic market (Verhoogen, 2008). In my view, there are three main reasons that explain why maquiladora firms sell a very limited amount of their final output in the Mexican domestic market. The first reason is historical. Maquiladora firms have historically received trade and tax exemptions provided that all of their final output was exported. Thus, in the context of international production networks, foreign assembly firms still see Mexico as a transitory location in their objective of supplying a major end market such as that of the US. In short, maquiladora firms still mostly come to Mexico to produce for the US market. The second reason is related to the import tariffs that maquiladora firms are required to pay when entering the domestic market. Even though maquiladora firms are now entitled to sell as much final output locally as they wish, they are still required to pay import tariffs. This applies to those maquiladora firms whose production does not use a sufficient amount of NAFTA inputs (tariff jump). It is also important to mention that the Mexican government maintains these additional restrictions to protect local producers and/or to encourage the joining of other export promoting programs in Mexico. The third and most important reason is precisely the existence of other export promoting programs that run parallel to the maquiladora one. For instance, the PITEX program (devised in the mid-1980s) was designed to support those firms that produce both for exports and for domestic consumption. Since this program was also devised during Mexico's opening up, foreign firms could choose between the maquiladora and PITEX programme according to their own productive objectives. The PITEX program and its relationship with the maquiladora program is discussed in detail in sections 2.9 and 2.10.

2.8 The Evolution of Maquiladora Firms through Manufacturing Sectors.

In this section, we present the general policy frameworks and the specific features characterizing different maquiladora manufacturing sectors. Our main objective here is to understand why some sectors are more likely to increase their demand for domestic inputs than others.

2.8.1 Food Industry.

According to Rama (1984), even before the opening of the Mexican economy, the food industry in this country was highly dominated by multinational firms. By establishing operations in Mexico, the main objective of these multinational firms was to produce food products, mainly using foreign inputs and demanding very little domestic inputs from Mexican agriculture. Several factors are behind this. First of all, most of the multinational firms in the food industry located in Mexico were of US origin. Therefore, those firms were used to using abundant and cheap agricultural inputs that were highly subsidized by the US government. Some of those agricultural products included wheat, soy, sorghum and milk where the US is a top producer. Similarly, the fact that those multinational firms did not specialize in the production of Mexico's top agricultural output (corn, beans and rice) and the relative backwardness of the technology employed in the Mexican agriculture were other incentives for the multinational firms to demand little Mexican inputs.

By 1985 the Mexican government tried to impose some restriction on agricultural imports given the country's entrance to GATT. Among others, import restrictions included 45% of tariff imports for condensed milk, 50% for butter, 10% for sorghum, 40% for corn, wheat, soy, beer, wine and so forth (GATT, 1986). The restrictions for imports of sorghum were removed in 1994, those for wheat, milk and soy in 2003 and those for corn in 2008 (Schwentesius Rindermann and Gómez-Cruz, 2001). Given the limited presence of food multinationals within the maquiladora industry, those firms did not receive special attention in the industry's policy framework. At this regard, we can only mention the tariff exemptions on imports of milk (powder), eggs, corn (powder), sugar and so forth issued in the 2002 maquiladora decree.

2.8.2 Leather and Footwear Industry

At the beginning of the 1980s, as a result of the debt crisis, the leather and footwear industry began to suffer from the decline in domestic purchasing power. Nevertheless, the main negative shock for this industry came with the opening up of the domestic market and with a reform issued in 1988, in which tariffs on imports were drastically reduced and import licenses were abolished. From June 1985 to December 1988 the value of domestic production covered by import licensing fell from 99.1 to 0% and the average tariff decreased from 46.8 to 18.1%. In response, imports grew from 0.2 million pairs in 1987 to 107 million pairs in 1991. This dramatic increase in imports was accompanied by a contraction in domestic production from 245.2 to 199.6 million pairs. In this new competition, Mexican shoe manufacturers were initially ill-equipped to compete with imports on price, quality and fashion content (Rabellotti, 1999).

Acknowledging the difficult situation faced by the leather and footwear industry, the Mexican government imposed several import restrictions. In 1993, countervailing duties were imposed on shoes and shoes' components imported from China, ranging from 165% to 1,105% according to the type of shoe (in the case of shoe leather, the import tariff was of 323%) (SECOFI, 1993). Nonetheless, with NAFTA in operation, more footwear imports entered taking a larger share of the domestic market. NAFTA also brought more pressures to domestic suppliers in the footwear industry since there were great difficulties in the supply of raw materials and particularly in the supply of bovine leather (Ortiz and Martinez, 2000). In this context, many producers substituted domestic supplies with cheaper and higher quality imported supplies (Woodruff, 1998). By 2001, given China's accession to the WTO, Mexico was able to extend for a period of six years the import tariffs imposed on Chinese products (including shoes) (Secretaría de Economía, 2007).

2.8.3 Paper and Wood Industry

Mexico does not have the necessary forest to support its paper industry. This is because there is an insufficient domestic supply of wood pulp. According to Cortez-Ruiz (1993), approximately 25% of the Mexican territory is covered by woodlands, divided almost equally into temperate (softwood) and tropical (hardwood) forest, covering 25.5 and

24.1 million hectares, respectively. Nevertheless, out of the total woodlands, only half of it can be actually used for wood manufacturing production. Similarly, other factors also indicate the limited role of the paper industry. At this regard, we can mention the continuous deforestation of woodlands (as a result of increasing urbanization and the expansion of other agriculture-related sectors, such as cattle rising), the fact that property rights over land are not well defined, and that many of the woodlands are located in remote and inaccessible areas.

Furthermore, wood products from Mexico were regarded by manufacturing producers as being of low quality and with non-competitive prices in international markets. This is mainly because of the fact that the wood production in Mexico has to compete with that of Canada and the Unites States. Those two latter countries are among the world's largest exporters of forestry goods. Therefore, their technology and scale of production also allows them to domestically supply forestry goods of high quality and low price.

In this background context, and as a result of Mexico's opening up to foreign trade during the 1980s, the exports of forestry goods increased from 71 millions of dollars in 1983 to 251 million in 1991; nevertheless, the imports rose from 237 million to 686 million during the same period of time. Out of those 686 millions of imports of forestry goods, 447 million were solely imports of wood pulp (Cortez-Ruiz, 1993). The Mexican government implemented several policy changes aimed at transforming the rigidity and backwardness of forestry sector (Ley forestall de 1992). Nevertheless, the signing of NAFTA increased the incentives to import forestry woods and materials from the United States and Canada further deteriorating any possible increase in the domestic consumption from the Mexican paper industry. The difficult situation observed in the forestry industry has not changed much during the more recent years. According to De la Madrid (2009), the trade deficit in forestry goods moved from 3.6 billion dollars in 2000 to 5.6 billion in 2008 (representing 38% of the total trade deficit in Mexico). In 2008, the main imports of forestry goods were paper and cardboard, wood and manufactures of goods, wood pulp and recycled paper.

2.8.4 Non-Mineral Metallic Industry

The non-metallic minerals include gypsum, glass and cement. The cement industry has important linkages with manufacturing production given that its output can be used as an input for the production of other goods such as bathroom furniture, pipes and so forth. During the 1980s, the cement industry experienced a major expansion in Mexico. According to Salomón (1995), from 1983 to 1989 the exports of cement had an average growth rate of 42.6, with most of such output being sent to southern part of the United States and with very little competition from US producers. The relative abundance of mineral resources in Mexico, the adoption of new technologies, the access to energy with preferential prices (mostly oil during the 1970s), the increasing substitution of labor for capital (late 1980s), and the strategic alliances of Mexican firms with US firms in order to distribute production in the US market (Cemex- Texas-Lehigh Cement in 1986) largely account for this issue.

After 1994, the situation in the cement industry and in the non-mineral metallic industry in general faced major changes. The implementation of NAFTA implied that the tariffs on imports of pure glass and pure gympsum were removed by 1994. Similarly, the tariffs on the imports of gympsum and cement were lifted in 1998, while the tariffs on imports on pure cement were eliminated in 2003. During the early 2000s, there was a significant expansion of demand from the construction industry in the US that imposed higher quality demands on the imports from Mexico. On the other hand, it Is also important to mention that the production of gympsum in Mexico (other major non-mineral metallic sector) faces important challenges given the current tendency for domestic manufacturers to import cheaper gympsum from elsewhere (Secretaría de Economía, 2013).

2.8.5 Transport Sector.

By 1962, Mexico establishes its first transportation decree under the highly protectionist scheme of ISI. During most of the 1960's and 1970's the Mexican government limited the participation of foreign investors in the transport sector (up to 40%) and prohibited the imports of vehicles, and of parts and components that were locally produced (Brown, 1997). More importantly, the minimum local content for the automotive production in Mexico was 60% (Vicencio Miranda, 2007). As a result of the opening up the economy in the mid-1980's, all these restrictions were lifted. Nevertheless, according to Brown (1997), one important exception was that local automotive suppliers should produce with at least 36% of domestic content. By the mid-nineties, NAFTA further modified this framework. In line with the agreement, automotive exporters had to meet very strict rules of regional content starting with 50% in 1994 so as to reach 60% by 2001. Mexico's advantageous geographical position (that allows for low shipping costs), its growing domestic market, low labor costs and its network of trade agreement make the country a very competitive location for automotive production. As a result of this process, the production of other important transport industries (such as the Aeronautic sector) has started to boom in the country (Carrillo and Hualde, 2013).

2.8.6 Machinery and Equipment.

Following the Mexican oil boom by the end of the 1970s, the government implemented an ambitious industrialization program. Such program was named "Plan Nacional de Desarrollo Industrial: 1979-1982" and its priorities were the agro-industrial sector and the domestic production of capital goods. In order to promote the production of capital goods, several policies were put in place. The government was expected to purchase 40% from the total production of machinery and equipment. Furthermore, the domestic production of machinery and equipment was to be purchased by the government at a price 15% higher than the market price. The government also offered to pay the transportation costs. Following the same stream of ideas, the government also offered fiscal credits (25% for new investments) and preferential prices for electricity, fuel oil, natural gas, and basic petrochemical goods (Bancomext, 1979). Nonetheless, the government decided to stop this whole program due to the debt crisis faced by Mexico in 1982.

According to USITC (1993), Mexico's effective tariffs on imports of industrial machinery from the United States, based on Mexican trade data for 1990, range from 10.1 percent ad valorem for textile machinery to 15 percent for construction machinery, and to 16.7 percent for refrigeration and heating equipment.

Under NAFTA, Mexico eliminated duties on about 54 percent of industrial machinery imports from the United States. This included duties on about 80 percent of Mexican imports of textile. paper industries, printing trades, and farm machinery, and 85 percent of food products machinery. About 17 to 33 percent of Mexico's imports of mining machinery, oil and gas field machinery, and refrigeration and heating equipment also became duty-free immediately (USITC, 1993).

2.8.7 Electronic Sector.

During the 1980s, as the level of production increased, more complex technological procedures were introduced in the maquiladora firms within the electronic industry. According to Brown and Dominguez (1989), microelectronic machinery was introduced with the intention of better controlling the productive process and reducing labor costs. Such microelectronic machinery replaced some of the assembly operations and the old machinery used by the maquiladora that was initially used by the headquarters located abroad (Brown and Domínguez, 1989). Since the 1980s, local suppliers to maquiladora electrónica have faced a number of obstacles that prevented them from increasing their supply of intermediate goods to such industries. Long term relationships historically formed between foreign supplier and electronic maquiladoras, certificates for the quality of production demanded by maquiladora producers, continuous changes in the design of electronic products, modularity in the manufacturing of electronic goods, emergence of more efficient producers and important decreases in the transportation and communication costs during the last decades can explain this phenomenon.

Given the importance of the electronic industry, the Mexican government has tried to support maquiladora producers in this industry as much as possible. For instance, 2001 was a critical year for electronic maquiladoras (and for the maquiladora industry as a whole) given the US crisis and China's accession to the WTO. As already mentioned, in line with NAFTA article 303, by 2001 only NAFTA-originated inputs were to be exempted from import tariffs. This NAFTA article 303 was meant to provide higher incentives for the manufacturing production within the North American region. Therefore, this article could be used as an instrument to support local suppliers of electronic inputs to maquiladora producers.

The PROSEC program was supposed to be one of the key strategies to help Maquiladora cope with the new NAFTA regulations and with the expected industrial emergence of China. Nevertheless, in order not to lose competitiveness in the electronic industry, the Mexican government implemented by 2002 yet another program named ITA-Plus (Olliver-Fierro, 2007). In 1996, Mexico did not take part in the WTO initiative named "Information Technology Agreement" (ITA) that considers the tariff elimination on diverse final goods (including their sub-assemblies) from two sub industries: (1) computers and, (2) telecommunications. Given the difficult situation faced by electronic maquiladoras by 2001, Mexico unilaterally established the ITA-Plus. ITA-Plus completely eliminates tariffs on intermediate goods imported from any country for three sectors: computers (computers, monitors, printers, scanners), telecommunications (modems, cellular phones, carrier - current line systems and telephone centers, broadcasting equipment for T.V. and radio), and other consumer electronics devices (TVs, stereos, CDs, video equipments, calculators, photocopiers, register machines). Furthermore, the ITA Plus considered the tariff elimination on raw materials and inputs from sectors such as steel, plastics and chemicals only to be used in the manufacturing of electronic products in Mexico (Secretaría de Economía, 2002)

In this context, the program was named ITA-Plus because, unlike ITA, it considered not two subsectors but three subsectors within the electronic industry (computer, telecommunications and consumer electronic devices and therefore, the electronic industry as a whole) and it included tariff exemptions on raw materials to be used on the manufacturing of electronic goods. ITA only included the free imports on subassemblies, while ITA plus also included free imports on raw materials (those inputs needed to produce subassemblies).

To my view, ITA-Plus was an important boost for maquiladora producers in the electronic industry but it did not promote the domestic production of subassemblies and components for the electronic industry. This can be further confirmed by analyzing the type of inputs that are provided by local producers to the maquiladora electronica. According to Carrillo and Zárate-Cornejo (2003), the intermediate goods that local suppliers send to the maquiladora electronica are inputs for indirect use. Inputs for indirect use mean those inputs that are mainly used in the last stage of manufacturing production (i.e. those that complete the final manufacturing outcome). Thus, the main inputs sent by local producers to maquiladora electronica include corrugated fiberboard, accessories for metal casting, instruction manuals, wooden pallets, polyethylene, foam, uniforms, packaging and so forth. Carrillo and Zarate-Cornejo (2003) also indicate that local electronic suppliers do not produce for a single maquiladora firm but their customers are diversified. Similarly, there are many differences among the local suppliers of electronics in terms of the machinery and equipment, organization procedures, infrastructure, access to final support and so forth.

Finally, the size from the local suppliers providing inputs to the maquiladora electronica also confirms the limited interaction between them. The size of those local suppliers of electronic goods is small. According to estimates provided by COLEF (2002), there are only 12 firms (employing in total less than 3000 workers) that supply intermediate goods to the electronic maquiladoras in the cities of Tijuana and Mexicali. This is quite a small number if we consider that there are 40 foreign firms supplying inputs for the electronic maquiladora employing nearly 14, 000 workers.

2.8.8 Services.

During the beginning of the maquiladora program, multinational firms within this industry used to rely on a large amount of services offered by domestic firms. Renting of industrial units, transportation, customs tariff advice, legal advice, services for the hiring and provision of labor (mostly low qualified labor) and shelter type of services are some of most common services provided to maquila firm. All these are non-tradable services that are specific to the Mexican economy (González-Aréchiga et al., 1991).

As the maquiladoras started expanding their operations in the mid-1980s, they started importing a higher amount of services. Multinational firms located abroad sent different kind of services to their Mexican subsidiaries (Maquiladoras) that were aimed at increasing the quality of the production and align the Maquiladoras with their organizational structure and standard procedures. The Maquiladora decree of 1989 and of 1998 indicates that those firms were allowed to import (free of duty) the following services; blue prints, manuals for labor training, equipment for the administrative performance of the firm, for control quality, for industrial security, those for hygiene and waste management purposes as well as devices for telecommunications. Similarly, the decree aimed at facilitating the entrance of foreign administrative workers and technicians to support maquiladora production.

In light of the increasing fragmentation of production, policy makers in Mexico implemented some legal changes in order to allow for the existence of more firms (both domestic and foreign owned) that could supply different types of services to maquiladoras. In 1998, the maquiladora decree recognised for the first time, the existence of the Maquiladora por servicios (services for maquiladora) and by 1997 the "Programa de Importación Temporal para Servicios Integrados a la Exportación" (services for PITEX) was implemented. The Maquiladora-Services firms and the PITEX services firms received tariff and import incentives provided that they supplied services aiming at facilitating the exports of regular maquiladora and PITEX firms respectively. Those services to facilitate exports (provided both by foreign or domestic firms) include port services, services for engineering, designing, research and repairing of machinery.

Let us indicate one example as to how services maquiladora can support the exporting activity of regular maquiladora firms. The regular (manufacturing) maquiladora firms transfer their final output to service maquiladora firms in order for those firms to perform the exporting activity. This means that exports of final output can be performed by the services maquiladora, while the regular maquiladora only focuses on the production process. The services maquiladora has to provide a certificate to the regular maquiladora firm in order for the latter firm to claim its tariff and import incentives (Gambrill, 2002). This type of service provided by the Maquiladora por servicios is quite convenient for the regular Maquiladora firms because, in that way, they can solely focus in the manufacturing process leaving the bureaucratic part of exporting to specialized Maquiladora services firms.

Finally, the IMMEX decree of 2006 further indicated the different activities that can be performed by the Maquiladora of services in order to support the exporting activity of regular Maquiladora firms. Those include; (a) storage and distribution of goods; (b) testing and classification of goods; (c) packaging, painting and polishing of goods (as long as the good is not modified); (d)embroidery, washing and ironing of textile goods; (e) waste management activities; (f) software engineering, and; (g) services to support information technologies.

2.9 The Development of Other Export Promoting Programs in Mexico (1985-2006).

In line with the opening of the economy, by the mid-1980s, the Mexican government established additional export promoting programs that were to coexist with the maquiladora program. Here, we are referring to programs named PITEX, DIMMEX, Drawback System, Carta de Crédito, ALTEX and ECEX. Unlike the maquiladora program, these new export promoting programs were not only aimed at foreign firms located in Northern Mexico that wish to produce for exports. Those new programs were designed for foreign and domestic firms located anywhere in Mexico, wishing to produce both for exports and for the domestic market. Further incentivizing manufacturing production to reduce Mexico's dependence on oil exports was the main objective behind those new promotion programs. A growing consumer class in Mexico, outdated and inefficient domestic production during the early 1980s and, the existence of these new promotion programs were important factors to induce foreign companies to start producing for the domestic Mexican market (Rice, 1998). In the next paragraphs, we will explain those new programs in detail, with a strong focus on the largest and most important program, the PITEX program.

2.9.1 PITEX, DIMMEX, the Drawback System and, Carta de Crédito Doméstica.

Once the export oriented strategy kicked in, Mexican policy makers wanted to devise a program that was similar to the maquiladora but targeting firms in domestic manufacturing (Acevedo Garat, 1987; Gambrill, 2008). The main objective of this new program was to make firms in the domestic manufacturing of Mexico as competitive as the foreign assembly firms within the maquiladora program. In the view of policy makers, such a second maquiladora program should be attractive for new foreign firms seeking to produce both for exports and for the domestic markets, as well as for existing domestic firms already producing for the domestic market that wished to start producing for exports. More importantly, joining this new export promoting program should be a realistic option both for large firms as well as for small and medium enterprises.

In this context, by 1985, Mexican policy makers implemented this new second export promoting program (parallel to the existing maquiladora) named "Program for the Temporary Import of Goods to be Exported Back" or PITEX (Programa de Importación Temporal para Producir Artículos de Exportación) (Dussel Peters, 1995). To allow for the participation in this program from small and medium enterprises as well as large firms, PITEX conditioned tariff incentives on the basis of two different export performance requirements. For instance, firms producing for the domestic market that exported more than 500,000 dollars or at least 10% of their total output were allowed to import the following items free of duty: a) raw materials and intermediate inputs; b) packaging materials; c) fuels, lubricants and spare parts. On the other hand, firms producing for the domestic market that exported more than 30% of their total output were allowed to import free of duty items a), b) and c) as well as d) machinery and equipment and; e) devices, equipment and accessories for research purposes, for industrial safety, control quality and training of personal. In my view, having two different export performance requirements was a useful idea for the export development of small and medium enterprises in Mexico. Firms that could only afford to produce a limited amount of good for exports (10% of their total output) could enjoy the basic PITEX benefits (items a, b and c). However, those firms also had an incentive to increase the scale of their production for exports beyond 10% as they could also import free of duty not only packaging materials and intermediate inputs but also machinery equipment as well as other more complex devices included in items d) and e).

Inducing more and more domestic firms to start producing for exports by means of PITEX also implied dealing with additional obstacles. By 1985, the export-oriented strategy was still something rather new and thus many domestic firms lacked the necessary capabilities and incentives to compete in international markets. Another important issue was the support for domestic suppliers. Domestic suppliers had not succeeded in producing inputs for maquiladora firms and now feared that the import incentives provided within PITEX would make domestic firms demand progressively less local inputs. One final obstacle was that the protectionist scheme had not been completely dismantled and, thus several import and ad-valorem duties still have to be paid for several items.

Acknowledging these additional obstacles, policy makers also devised by 1985 other promotion schemes that were complementary to the new PITEX program. In order to induce domestic firms to produce for exports with local content, a program named DIMMEX was implemented. DIMMEX stands for Import Duties on the Production for Exports (Derechos de Importación de Mercancías para Exportación). Here, domestic firms that bought at least 30% of their inputs domestically could obtain a DIMMEX certificate which allowed them to import intermediate goods free of duty. Nevertheless, obtaining a DIMMEX certificate did not exempt domestic firms from paying ad-valorem import tariffs of 10% or the tariff percentage established by the Mexican Custom System (if it was higher than 10%) (Acevedo Garat, 1987). To help firms deal with this additional tariff issue, a Drawback system was also implemented in 1985. In this Drawback system, domestic firms producing for exports were allowed to ask for the full reimbursement of the import tariffs they paid, provided that their imported goods were effectively used in the production for exports (Acevedo Garat, 1987).

DIMMEX and the Drawback system were devised as the first steps to achieve PITEX status for less export oriented domestic firms. To explain such mechanism, let us refer to the example of a domestic Mexican firm in the early 1980s as described by Salinas Chavez (1990). In 1985, in light of the opening of the economy, a Mexican firm producing for the domestic market wanted to produce for exports. To produce for exports and compete in international markets, the domestic firm needed to increase its consumption of imported inputs of higher quality. As a result of the protectionist scheme lifted in 1983, this firm would find it easy to obtain import tariff exemptions by means of a DIMMEX certificate. This, because It was quite likely that this firm source more than 30% of their total intermediate inputs domestically. Though the ad-valorem import taxes were not exempted by DIMMEX, the Mexican firm could ask for a full reimbursement of those taxes using the Draw-back scheme. Even though those instruments would allow the production of more output for exports, the Mexican domestic firm would find desirable to avoid the payment of import tariffs and the bureaucratic procedure of the Draw-Back system.

As the firm increased its production for export (a minimum of 500,000 dollars annually or 10% of their total sales), it could apply for a PITEX scheme. By becoming a PITEX firm, not only could it import its main imported inputs free of duty, but also packaging, fuels, lubricants, machinery and equipment, instruments for control quality and so forth. PITEX also exempted firms from the need to obtain import certificates, so our Mexican firm no longer required a DIMMEX. Similarly, the draw-back system was no longer required since there were no more import taxes to be reimbursed. So, with PITEX, our Mexican firm could obtain in a single program all the benefits that were obtained separately with other policy instruments, plus important benefits for its production processes.

The benefits from PITEX and from the Drawback system could also be extended to local producers of intermediate inputs (Acevedo Garat, 1987). Furthermore, an additional program was also devised to ensure the participation of those local producers in the production for exports from domestic firms. By 1985, the Mexican government implemented a program named "Carta de Crédito Doméstica", which had the objective of issuing bank guarantees for the production of local suppliers. According to Acevedo Garat (1987) this program had already been implemented in South Korea and was expected to have the same positive outcome for local suppliers in Mexico. Carta de Crédito Domésticas (letter of credit for domestic purchases) is a bank guarantee that can be issued by an exporting firm located in Mexico to be granted to its preferred domestic suppliers. For the banking system, this letter of credit guaranteed that the exporting firm was going to purchase some determined amount of domestic inputs from local suppliers in Mexico. Therefore, local suppliers could use such letter of credit to ask for loans within the Mexican banking system in order to buy machinery, equipment and so forth.

As can be seen from this discussion, the main objective of the Mexican government was to induce more and more firms in domestic manufacturing to achieve PITEX status. Both direct and indirect exporters had the necessary complementary programs to progressively increase their production for exports and obtain more benefits as PITEX firms. Since its inception the manufacturing sectors that have mostly used the PITEX scheme are Chemical products, Basic Industries (such as steel and Iron) and, more importantly, the transport equipment (autoparts) sector. According to Ramos (1989), during the period 1985-1987 the autoparts industry in Mexico accounted for 34% of the total imports under the PITEX scheme and 50% of the total exports under PITEX. For the same period, the corresponding figures for Chemical products and for Basic Industries were smaller than 10% respectively, while the rest of manufacturing subsectors (39 sub sectors) studied by Ramos (1989) jointly import 37% of total PITEX imports and 25% of total PITEX exports.

Over the years, until the creation of the IMMEX program, the general framework governing the operation of PITEX firms did not change substantially. The most important change for the PITEX program took place with the implementation of NAFTA. In line with the agreements, one additional benefit from the PITEX program was to allow foreign investors to register as a national supplier to the automotive industry (USITC, 1998). By 2006, PITEX firms numbered 3,620 and included all motor vehicle assembly parts and most of their part suppliers. Historically, these firms tend to locate in the interior of Mexico because an important part of their sales goes to the domestic market (De la Cruz et al., 2011) and due to the proximity to a major end market such as Mexico City.

2.9.2 ALTEX and ECEX.

On top of the previously mentioned programs, Mexico implemented two additional export promoting schemes that aim to separately support two radically different groups of domestic firms. The ALTEX program was designed to support those highly competitive exporting firms in the domestic manufacturing sector of Mexico, while the ECEX program was prepared for the increasing participation from the rather small domestic firms in the production for exports. The main difference with respect to the above-mentioned programs was that, in this case, financial support could be provided for ALTEX and ECEX firms. Similarly, firms joining ALTEX and ECEX could also qualified and be registered as PITEX firms.

According to Dussels Peters (2000), the High-Exporting Firms program (Empresas Altamente Exportadora, ALTEX) was issued in 1986. High exporting domestic firms were those that had a dynamic and permanent participation in international markets (SECOFI, 1990). To qualify for ALTEX, a firm should export directly more than $ 2 million dollars or 40% of their sales, or indirectly 50% of their sales. Some of the most relevant benefits for ALTEX firm were quick return of value added taxes and quick revisions in customs (Dussel Peters, 2000).

On the other hand, the ECEX program was issued in 1990. ECEX stands for Enterprises to Facilitate Foreign Trade (Empresas de Comercio Exterior). An ECEX firm is the one that facilitates and promotes the exports of goods that have been produced by several domestic firms of rather small size. According to Hernández Laos (2000), ECEX was aimed for those micro, small and medium firms that as individual entities lack the necessary capabilities and resources to produce for exports. An ECEX firm will then gather the final output from those small individual firms and export to international markets on their behalf. The final output exported by an ECEX firm should be homogenous, of the same quality and originally produced by micro, small and medium firms. A minimum of US$ 100,000 is required to start operations as ECEX firm. After the second year of operation within ECEX program, the firm should yearly export more than US$ 3 million and keep a positive surplus (Hernández Laos, 2000). Financial support is available for ECEX firms wishing to induce for micro firms to produce for exports.

2.10 Similarities and Differences between the Maquiladora and PITEX Program.

Having separately explained the main characteristic from Mexico's two major export promoting programs, we will now describe the main similarities and differences between them. On the one hand, we observe that Maquiladora and PITEX firms receive the same kind of import incentives and allow for the same levels of foreign ownership. On the other hand, we will show that those two programs differ in terms of the location of firms, the export requirements to receive benefits, the share of domestic sales and fiscal obligations.

2.10.1 Duty Free Imports and Foreign Ownership

Firms under the PITEX or Maquiladora program, being direct or indirect exporters, can temporary import various items to be used in their production for exports free of duty. Packaging materials, intermediate inputs and machinery and equipment were some of goods that could be imported duty free. Likewise, both types of firms faced no restrictions in terms of foreign ownership (up to 100%) and could set up operations anywhere in Mexico. Finally, a firm enjoying maquiladora status could apply for PITEX benefits, and vice versa, as long as its participation in the two programs does not refer to the same good, i.e. there is no overlap of programs (Rice, 1998)

2.10.2 Performance Requirements.

Maquila and PITEX firms had to meet different export performance requirements to receive the corresponding benefits within each program. As mentioned before, PITEX were required to export at least 10% of their final output in order to temporararily import intermediate inputs and packaging materials free of duty. If the same PITEX firm wished to additionally import machinery and equipment free of duty, the export requirement for this was a minimum of 30% of total sales.

Maquiladora firms, on the other hand, did not have to meet any specific export performance requirement to obtain their benefits (they could export 100% of their production if they wished to). Nevertheless, unlike PITEX firms, the only two requirements that maquiladora firms had to meet in order to continue receiving preferential treatment were 1) employing and training a certain number of Mexican workers, and, 2) complying with their fiscal obligations. According to Rice (1998), imposing labor obligations for maquila firms had the following three goals; to encourage the employment of Mexican nationals in higher level positions, to improve the technical qualifications of workers, and to contribute to the overall integration and competitiveness of the Mexican industry. No specific employee training standard existed, though. Rather, the maquiladora firm only needed to demonstrate the implementation of some training activities.

2.10.3 Domestic Sales of Final Output

Since its inception in 1985, firms belonging to the PITEX program were entitled to sell a higher amount of final output domestically than maquiladora firms. As mentioned in section 2.7, during the 1990s, maquiladora firms were allowed to sell progressively more output on the domestic market. By 2001, maquila firms just like PITEX finally faced no restriction to selling their output domestically. Nevertheless, when selling domestically, both maquiladora and PITEX firms were also required to pay tariffs on those imported goods that were subject to taxation (those intermediate inputs not protected by NAFTA or that came from countries with which Mexico does not have a free trade agreement).

2.10.4 Fiscal Obligations.

One of the most important differences between the Maquiladora and PITEX program was related to the amount of taxes that firms within each program had to pay. In general, maquiladora firms used to pay less taxes than PITEX firms but, with the boom in production triggered by NAFTA, the maquiladora program was modified to increase the fiscal obligations of maquiladora firms.

Corporate income tax, assets tax, and value added tax (VAT) for both domestic sales and imports are the federal taxes that PITEX and maquiladoras have to comply with. The corporate income tax is a flat 34% and the assets tax is 1.8% of all business assets. The VAT is variable but on average is 10% of all sales of goods and services. According to Rice (1998), the primary fiscal benefit for maquila and PITEX firms derives from not having to pay import duties or the value added tax on the cross-border transfer of goods. Nevertheless, before 1998, PITEX firms were also required to pay income and/or asset taxes while maquiladora firms were exempted from paying these.

The main reason for PITEX firms to pay income/asset taxes was that Mexican legislation treated them as profit centers. PITEX firms were considered as traditional manufacturing firms that could be taxed on their profits and that could also be required to sell foreign currency to cover both profits and operating costs. Maquiladoras, on the other hand, used to pay little or no income /assets taxes because they were not operating as profit center buts as cost centers. Costs centers implied that maquiladora firm did not produce sufficient profits as they often leased machinery and equipment from their foreign headquarters (Rice, 1998). Similarly, maquiladoras paid income taxes on their country of origin once the foreign headquarters reported its total income (which included the one obtained by its maquiladora subsidiary).

In this context, during the mid-1980s and early 1990s, the choice between PITEX and Maquiladora status boiled down to a technical decision weighing the subtle and complicated differences in foreign exchange requirements and tax treatment (Wilson, 1992). The boom in maquiladora production that took place in the years after the implementation of NAFTA implied a drastic change in the fiscal obligation of those foreign assembly firms. By 1998, Mexican authorities no longer regarded maquiladora firms as a cost centers but as profit centers just like PITEX firms. The main implication behind this policy shift was that maquiladora firms were now supposed to pay income taxes on the basis of their World profits just like any other foreign manufacturing firm in Mexico (Gambrill, 2002).

Maquiladoras now being regarded as profit centers according to the Mexican legislation implied a severe problem for those firms. Not only were they now required to pay taxes on their income produced in Mexico but also on the income reported by their foreign headquarters mostly located in the US. In light of this problem, by 1999, Mexican and US authorities reached an agreement to avoid double taxation. Such treaty prohibited double taxation and established that as a general rule, the Mexican entity (rather than the foreign partner) was required to pay taxes on the assets located in Mexico and any income generated from the Mexican operations (Rice, 1998). To calculate income taxes, Maquiladoras firms were required to implement arm's length transfer pricing or safe harbor transfer pricing. Finally, given the drastic decline in maquiladora output that occurred in 2001, by 2003, Maquiladora firms were allowed apply for a tax credit resulting in a reduction of the maquiladora's income tax liability (E&Y, 2010).

2.11 IMMEX Program (2007-present): Merging PITEX and Maquiladora firms.

As discussed in the previous section, the maquiladora and PITEX program had progressively reduced their differences in terms of fiscal obligations and the permission to sell domestically, tariff duties when importing intermediate and capital goods, and were subject to the same set of rules of foreign ownership. Before 2006, the largest differences between maquiladora and PITEX firms had to do with the type of production (for exports or for the domestic market), the export performance requirements that they had to meet, as well as their location within Mexico. According to Rice (1998), the PITEX program was still largely oriented towards national and foreign producers wishing to expand their operations to include export manufacturing, while the Maquiladora program was intended for pure export companies.

Table (2.3) presents the distribution of maquiladora and PITEX firms across border Mexican states as well as other Mexican states in 2006. It also shows the number of firms in 2006 that were to become part of the IMMEX framework by 2007. In this table, we observe that by 2006 nearly all maquiladora firms were located in Northern Mexico (as discussed in section 2.4), while almost 65% of all PITEX firms were located in non-border states. Finally, export performance requirements of 10% and 30% for the import of intermediate good and of capital goods, respectively, remained only for PITEX firms and were not applicable for maquiladoras.

Table (2. 3): Mexico's Exporting Firms in the Maquiladora, PITEX and IMMEX Programs.

	Number of Plants			
Mexican States	**2006**			**2008**
	Maquiladoras	**PITEX**	**IMMEX**	**IMMEX**
Border States	2,283	1,269	3,552	3,625
Other States	512	2,351	2,863	2,560
Nationwide	**2,795**	**3,620**	**6,415**	**6,185**

Source: De la Cruz et al. (2011)

In light of the fierce competition triggered by the emergence of more efficient East Asian producers during the early 2000s, the Mexican government decided to implement a key policy change in its two major export promoting programs. As of 2007, maquiladora and PITEX firms were to operate within the same legal framework. Such new framework should also take into account those ALTEX and ECEX firms as they were also registered with PITEX status. This new single export promoting program was named

Manufacturing Industry, Maquiladora and Export Services Program or IMMEX (Industria Manufacturera, Maquiladora y de Servicios de Exportación).

According to Gambrill (2008), the main objective behind IMMEX was to make exporting firms in the domestic economy of Mexico (i.e. those registered as PITEX) as competitive as the ones in the Maquiladora program. In the view of Mexican policy makers, this latter objective could be achieved if both domestic and exporting firms enjoy the same rules of operation and the same incentives within a single promotion program.

In line with Table (2.3), by 2006, from the total amount of firms that were to become IMMEX firms, 56% were registered as PITEX and 44% were maquiladora firms. Given such number of PITEX firms and the intention of the Mexican government to promote the industrial development of those firms, the export performance requirements from the PITEX program were also transferred to IMMEX. Nevertheless, this time IMMEX firms (both Maquiladora and PITEX firms) were only required to export at least 10% of their total sales (or a yearly minimum of US$ 500,000) to import all the necessary intermediate inputs and capital goods free of duty and free of value added taxes. This export requirement of exporting at least 10% of total sales was maintained in order to continue to induce more domestic firms to qualify for IMMEX (Gambrill, 2008). Despite the larger number of PITEX firms initially included in IMMEX by 2006 (56% PITEX firms and 44% maquiladora firms, according to table 2.3), it is worth mentioning that the IMMEX framework still shows some of the main characteristics of the maquiladora framework. Here, we are referring to the location of most firms in Northern Mexico and the higher consumption of domestic inputs in non-border states. Table (2.4) presents the location of IMMEX firms in different Mexican regions from 2007 to 2016. In this table, we observe that more than 60% of total IMMEX firms are located in the border region while the remaining 40% is established elsewhere in Mexico. Here, we can also indicate that, over time, more IMMEX firms decide to operate in central Mexico away from the border region. Nevertheless, such latter tendency only takes place at a relatively slow phase.

Table (2. 4): Location of IMMEX Firms in Mexican Regions: 2007-2014.
Number of Establishments

Year	Northern Mexico	Central Mexico	Western Mexico	Southern Mexico	Other Regions	Total Mexico
2007	3,119	794	255	90	307	4,565
2008	3,180	1,056	263	88	319	4,906
2009	3,149	1,057	271	83	306	4,866
2010	3,078	1,043	265	82	286	4,754
2011	3,058	1,039	272	83	282	4,734
2012	3,053	1,068	302	77	284	4,784
2013	3,065	1,090	306	79	273	4,813
2014	2,977	1,112	284	68	264	4,705
2015	2,968	1,108	282	67	271	4,696
2016	2,990	1,118	276	60	269	4,713

Source and Notes: as described in table (2.1).

Similarly, in line with table (2.5), IMMEX firms located in Central and Southern Mexico consume more domestic inputs than those located in the Northern region. One important thing to notice is that, as results of the merging of PITEX and maquila firms into a single program, IMMEX firms show higher use of domestic inputs than the ones observed in previous years for maquila firms. Similarly, the total use of domestic inputs for all IMMEX firms in Mexico is twice as high as the corresponding figure for the last year of the maquiladora (24% in 2008 for IMMEX and 12% for maquiladora, respectively). The reason for such higher use of domestic inputs from IMMEX firms (than the one observed in maquiladora in table 2.2) is simply the result of including firms in the sample that were previously considered to be part of the domestic economy of economy that mostly relied on domestic inputs to produce both for domestic consumption and for exports (PITEX firms).

The information presented in tables (2.4) and (2.5) can be better understood by analyzing figure (2.3). Figure (2.3) follows the same structure as the one previously described for figure (2.2). Here, we can observe that, as a result of the growth in Mexican population with respect to that of 2005 (Figure 2.2.b), some of the Mexican states that are now heavily populated also present an important concentration of IMMEX firms. This is the particular of case of Chihuahua (CM) and Nuevo León (NL). Nevertheless, apart from this, we still observe that the vast majority of IMMEX firms are not located in the Mexican regions with highest population levels. We are again referring to those Mexican states that are colored in red in the map at chart (b) but that are left in blank in the map at chart (a) (both of them in figure 2.3). In addition those states that are heavily populated and that have a limited presence of IMMEX firms (Central, Western and, Southern) are the ones that show higher levels of domestic intermediate consumption, with respect to the demand for domestic inputs observed in North.

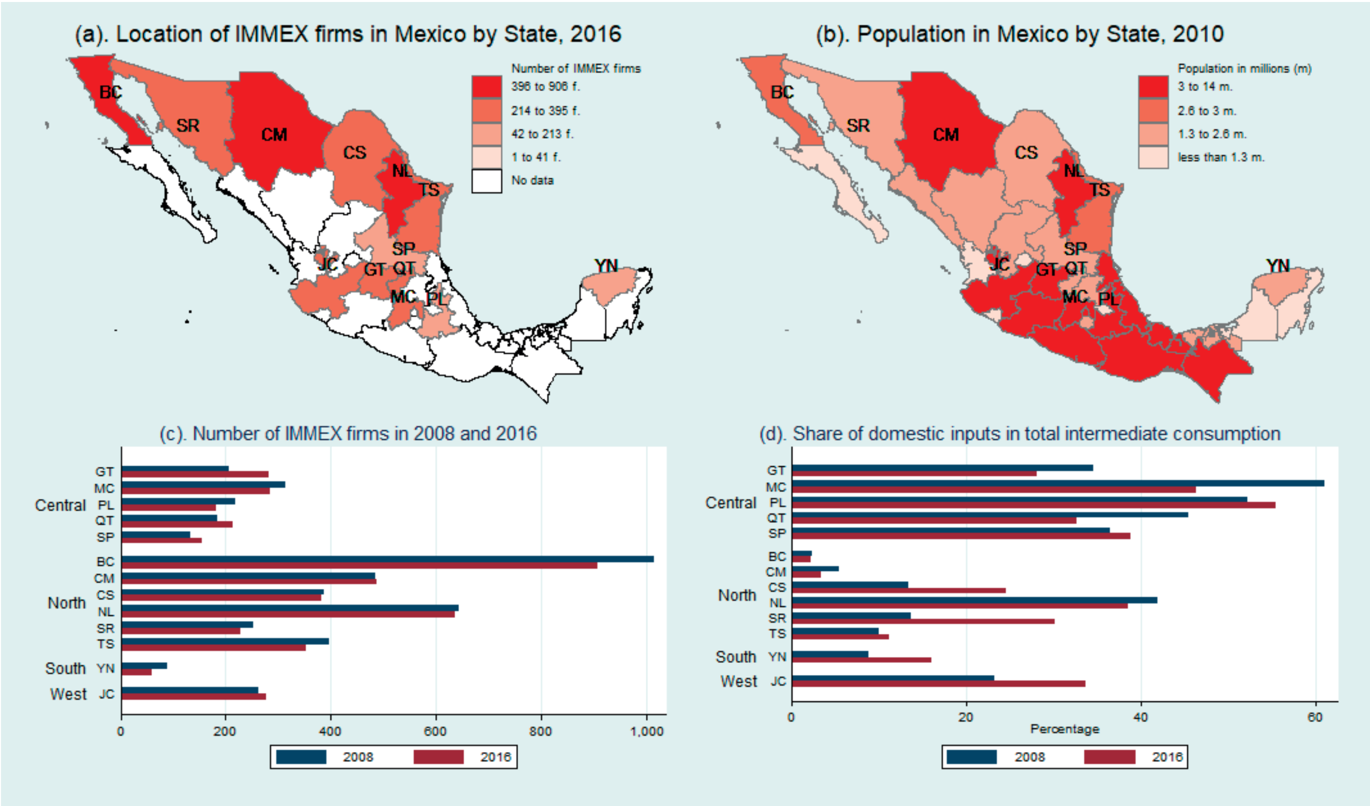
Table (2. 5): Share of Domestic Intermediate Consumption in Total Intermediate Consumption for IMMEX (All Manufacturing Sectors in Mexican Regions): 2007-2016.

	Northern Mexico							Southern Mexico		Total Mexico
Year	Baja California	Chihuahua	Coahuila	Durango	Nuevo León	Tamaulipas	Sonora	Veracruz	Yucatán	
2007	2.3	5.4	11.9	45.9	42.4	9.1	12.2	63.4	10.3	23.8
2008	2.3	5.4	13.4	42.9	41.8	9.9	13.7	64.2	8.8	24.0
2009	1.7	4.8	15.5	42.0	42.2	10.9	15.6	65.9	9.6	24.1
2010	1.9	5.2	33.3	36.5	46.5	17.7	15.7	77.7	13.1	28.6
2011	2.3	4.5	31.9	35.9	43.1	14.0	16.7	53.2	19.4	28.9
2012	2.9	4.8	34.1	35.8	40.8	15.5	18.8	58.8	21.7	30.4
2013	3.0	5.4	32.9	33.6	44.6	12.1	19.2	65.1	29.3	29.9
2014	2.4	5.9	29.6	25.5	43.1	15.8	20.8	58.7	16.8	27.9
2015	2.3	4.0	27.3	21.8	40.4	12.1	22.0	57.1	13.1	26.4
2016	2.2	3.3	24.5	19.3	38.4	11.2	30.1	56.5	16.0	24.8

	Central Mexico									Other Regions
Year	Aguascalientes	Distrito Federal	Guanajuato	Jalisco	Estado de México	Puebla	Querétaro	San Luis Potosí		
2007	30.1	61.6	36.6	21.8	59.1	54.8	46.8	34.6		46.2
2008	29.6	60.7	34.5	23.2	61.0	52.2	45.4	36.4		41.2
2009	31.3	61.4	35.5	20.2	61.2	48.6	43.7	43.3		45.2
2010	26.5	69.6	32.3	19.5	67.5	52.9	44.7	51.3		54.9
2011	26.9	72.9	27.7	25.1	67.7	53.4	45.0	47.7		53.3
2012	28.3	71.3	28.3	30.5	53.7	58.8	43.2	42.6		50.6
2013	28.0	72.9	37.3	30.6	58.7	59.3	35.3	42.3		53.2
2014	33.0	72.4	25.3	39.2	42.3	58.3	36.9	41.6		51.9
2015	35.0	70.2	32.3	35.8	43.4	57.8	33.9	40.5		54.4
2016	34.3	73.9	28.1	33.6	46.3	55.4	32.6	38.7		53.5

Source and Notes: as described in table (2.2)

Figure (2. 3): Different Regional Dimensions of IMMEX firms, 2008 and 2016.



Source: Author's calculation. For (a), (c) and (d), INEGI, Banco de Información Económica (www.inegi.org.mx/sistemas/bie). For (b), INEGI, Conteo Nacional de Población y Vivienda, 2010.

Notes. **GT**: Guanajuato; **MC**: Estado de México; **PL**: Puebla; **QT**: Querétaro; **SP**: San Luis Potosí; **BC**: Baja California; **CM**: Chihuahua; **CS**: Coahuila; **NL**: Nuevo León; **SR**: Sonora; **TS**: Tamaulipas; **YN**: Yucatán; **JC**: Jalisco.

Acknowledging new and different strategies to organize global production, the Mexican government allowed for the participation of new types of manufacturing firms within the IMMEX framework. In general, 5 types of firms were to receive benefits within the IMMEX framework. The first type of firms is IMMEX Industrial which included those firms that belong to the traditional concept of Maquiladora and PITEX (i.e. firms that only transform intermediate goods into goods for exports and/or for the domestic market). IMMEX Albergue is the second type of firm and includes those firms that perform shelter operations (those firms that perform assembling operations by receiving intermediate inputs or technology from different foreign clients). IMMEX Servicios, on the other hand, refers to those firms that provide services for the operation of other IMMEX firms. Under the new IMMEX framework, those firms are allowed to directly export services to other firms outside Mexico (they only used to export indirectly via other IMMEX firms). Thus, they are also entitled to import their own intermediate goods free of duty. According to PWC (2013), IMMEX service firms perform repairing, cleaning, quality control testing, packaging, greasing activities and technological support services (back office, share service centers).

IMMEX Controladora and IMMEX Terciarización are the fourth and fifth type of firms considered within the new export promotion program. These two types were not previously considered in the PITEX program nor in the Maquiladora regime. They were created and included in the IMMEX framework, given the emergence of new and different strategies to organize global production. IMMEX Controladora refers to those firms that control and administrate the temporary imports of several firms that belong to its hierarchical structure. IMMEX Controladora is the main legal representative of those firms with regard to the fiscal and custom authorities in Mexico. This new type of firm is created in order to allow for the decentralization of bureaucratic procedures across different subsidiary firms in Mexico that belong to the same organization.

Finally, IMMEX Terciarización refers to those firms that receive imported inputs from foreign clients but have no productive capacity to transform those inputs into a good for export. Thus, these firms operate by relying on third parties. This means that a firm registered as IMMEX Terciarización will have to find other IMMEX firm or other regular domestic manufacturing firm that has the productive capacity and that is willing to transform those imported goods into a final good. Once the IMMEX firm receives the final output transformed by a third party, it exports back the production to original foreign client.

In general, all the five types of IMMEX firms are also entitled to perform “sub-manufactura” operations. Sub-manufactura means that IMMEX firms can transfer imported intermediate goods to other firms not belonging to the IMMEX framework. According to Gambrill (2008), the main objective behind those transfers of imported goods was to incentivize the development of local suppliers that cannot access those imports because they cannot afford to or are not willing to become a IMMEX firm. This also means that the specific benefits enjoyed by IMMEX Terciarización and IMMEX Controladora can also be extended to the rest of IMMEX firms, i.e. IMMEX Industrial firms can also act as IMMEX Terciarización if they wish the send intermediate inputs for final processing to other third parties in Mexico.

IMMEX firms could still enjoy the benefits from the Sectoral Promotion Programs (PROSECs). As mentioned in section 2.3.3, by 2001, NAFTA required its signatory countries to impose tariffs on the imports of non-NAFTA inputs. In order not to lose the competitiveness, Mexico devised a program named PROSECs which allowed for the duty-free imports of the key intermediate goods used by maquiladora firms. Similarly, IMMEX firms also faced no restriction to selling a given percentage from their final output domestically. According to PWC (2013), any given portion of final output (with foreign content) may be sold domestically in the domestic market upon payment of the corresponding import duties on the foreign content thereof. Those imported intermediate goods that had to pay import duties were those that have not been transformed or processed in North American country to be considered of NAFTA origin. The reason for imposing those import duties was related to the fact that the Mexican government wanted to protect the production at its domestic market. Such protection would take place by limiting the foreign content of those final goods whose intermediate production mostly came from countries by which Mexico has not signed a free trade agreement (Most of the Asian countries). At this regard, for those countries where a free trade has not been executed, Mexico imposes the highest tariff at a 35% rate and custom processing fees at 0.008%. Those two tariff duties are computed on the customs value of goods, plus any other taxes according to the type of merchandise (Moore Stephens, 2017).

The benefits from ECEX and ALTEX programs were also included into the IMMEX framework. Such situation means that IMMEX firms can also apply for the benefits of ALTEX or ECEX and vice versa (PWC, 2013). As for income/asset taxes, IMMEX firms are still required to compiled with transfer pricing rules. To this end, they can rely on safe harbor rules, advanced pricing agreements, mark up method, or return on foreign assets (León-Santacruz & Luján, 2014). Firms belonging the IMMEX could also obtain tax credits (E&Y,2010) and apply for import duty drawback schemes (PWC, 2013).

The last important change in the IMMEX framework took place in 2014. From that year onwards, IMMEX firms were required to pay value added tax at the 16% rate on their temporary imports. IMMEX firms can apply for VAT crediting benefits provided that their imports belong to the production for global supply chains and receive a certificate from Mexican authorities (León-Santacruz & Luján, 2014).

2.12 The Future of Mexico's Export Promoting Programs: Industrializing the Underdeveloped Southern Region.

As observed in figure (2.2) and (2.3), most of the manufacturing production in Mexico (both for exporters and non-exporters) is concentrated in the Northern states. Firms setting operations in Northern Mexico enjoy unique access to the US market, efficient infrastructure and close proximity to efficient suppliers also located in the US. On the other hand, an incipient industrialization process has been historically observed in Southern Mexico. Unlike Northern states, Southern Mexican states suffer from high levels of poverty, inefficient or non-existent infrastructure, and an industrial environment where no competitive techniques are being implemented. According to CEFP (2016), three major Southen Mexican states (Guerrero, Chiapas and Oaxaca) produce less than 7% of Mexico's GDP but their joint population represents 15% of the Mexican population. Some of the competitive advantages offered by the Southern region (when compared to Northern Mexico) are relatively fast transportation between the Pacific and Atlantic oceans, proximity to Mexico's major oil regions, relative abundance of natural resources and low-qualified labor that is cheaper than anywhere else in Mexico.

By 2016, the Mexican government implemented a new industrial promotion program aimed at the specific industrial development of Southern states. This rather new program is called Zonas Económicas Especiales (Special Economic Zones) and its main objective is to help Southern states close their industrial gap with respect to the highly industrialized border region. Strict regional planning is required to decide where in Southern Mexico Special Economic Zones (SEZs) should be located. According to CEFP (2016), Special Economic Zones can only be located in regions with extreme poverty levels, with population levels between 50, 000 and half a million people and, in areas that enjoy a good connectivity to reach domestic and foreign markets. The most important requirement for SEZ is that firms joining such scheme should produce output in line with the region's productive potential and competitive advantages. The latter means that SEZs in Southern Mexico will not specialize in the production of Electronics or Transportation equipment (currently monopolized by IMMEX firms). Rather, they might specialize in producing textiles goods or natural resources based manufacturing.

Given that the SEZs program is rather new, policy makers in Mexico have not yet clarified the precise legal framework that will govern this new industrial promotion program. Little is known as to what kind of benefits and obligations those SEZs will receive. More importantly, it is still unclear if the SEZs program will be a 2016-Maquiladora strategy for the Southern region that will coexist with the current IMMEX program, in the same fashion that the old maquila strategy survived with PITEX firms. It could also be that SEZs firm will be immediately granted IMMEX status. In line with previous changes on Mexico's export promoting policies, we believed that policy makers will first observe the operation of the SEZs during some initial years before issuing a specific legal framework for those firms.

2.13 Conclusion.

This chapter studied the evolution of different policy instruments that Mexico has implemented to promote its production for exports over the last fifty years. The production for exports was initially supported within the Maquiladora framework by the mid-1960s. Given the ISI strategies prevailing at that time, the Maquiladora framework was only devised as a temporary program that would provide higher levels of foreign currency and employment. With the failure of ISI by important debt crises by the early 1980s, Mexico opted for an export-oriented strategy where the Maquiladora framework was to become one of the key cornerstones. Nonetheless, the Maquiladora industry was not only going to be the only export promoting framework (as was the case in the past). With Mexico's new outward orientation, policy makers devised a framework similar and parallel to the Maquiladora one, but aiming at the development of firms within its domestic manufacturing sector. This second exporting promoting framework (known as PITEX) was designed to induce domestic manufacturing firms to progressively increase their production for exports. With the PITEX framework, firms only producing for domestic consumption would start receiving import and tariff incentives similar to those received by Maquiladora firms provided that they started producing for foreign markets. Given the lack of competition and technological backwardness that most domestic firms faced during ISI, the government imposed different performance requirements for domestic firms seeking to participate in the PITEX. Those performance requirements for PITEX firms implied selling a certain percentage of output in foreign markets to freely import basic raw materials (10% of output in this case) and/or machinery and equipment (30% of output in this other case). Maquiladora firms faced much higher export performance requirements (exporting 100% of total output) but also faced rather flexible requirements in other issues such as increasing the technological capabilities of Mexican workers. In my view, by imposing different export performance requirements for PITEX firms, the Mexican government was not only encouraging more domestic firms to produce for exports. More importantly, by setting realistic export performance requirements (10% of total output) the government was allowing the participation of more Small and Medium Enterprises in the production for foreign markets and was inducing their industrial development by setting higher performance requirements for them to obtain higher benefits (30% of total output being exported as a requirement for freely importing machinery and equipment).

In this context, it can be observed that the export promoting policy framework in Mexico moved from isolating foreign assembly firms in a temporary and restrictive framework to promoting an increasing interaction of those firms with domestic firms. By including some of key elements from the Maquiladora framework to the PITEX program, the Mexican government succeeded in continuously increasing its production for exports.

Adapting the export promoting framework (Maquiladora and PITEX) to the requirements imposed by NAFTA and to the new context of international competition explains why Mexico became one of the key manufacturing powerhouses in the world. Mexican manufacturing firms significantly benefited from the trade incentives provided by NAFTA. Nevertheless, when NAFTA opted for higher regional integration (i.e. excluding third countries from receiving NAFTA benefitS), Mexico prioritized its participation in international production networks. Even though NAFTA required its signatory members to impose tariffs on the imports from non-NAFTA countries by 2001, Mexico devised a program to exempt non-NAFTA countries that had operations in the country from these new tariffs. Such a decision was taken in light of the large number of electronics firms in Mexico (specially within the Maquiladora program) that mostly sourced their inputs from East Asia. In this context, Mexico still prioritized the traditional benefits of an outward orientation strategy (higher output, employment, and foreign direct investment), while neglecting the opportunity of inducing those firms to source more inputs locally.

Given the stiff competition triggered by more efficient foreign producers during the early 2000s, the Mexican government sought for new alternatives to further promote its production for exports. The IMMEX framework merged firms belonging to Maquiladora and those in PITEX into a single program. In my view, the merging was an incremental step given that both programs had progressively reduced their differences with respect to each other. The key difference between PITEX and Maquiladora, which still can be observed in the IMMEX framework, is their location in different parts of the Mexican territory (Northern region for Maquiladora and Central Mexico for PITEX), as well as the fact that one solely produces for export while the other still mostly produces for the domestic market. The Mexican government expected to increase the competitiveness of its export sector by letting all its exporting firms coexist in a single framework with the same rules of operation, same performance requirements and same incentives. To further ensure the participation of SMEs, export performance requirement remained at 10% for all firms. The latest challenge for the Mexican government is to promote the industrialization in its poorest regions (Southern Mexico) by means of the program named Special Economic Zones (2016) and to let those new firms interact with those belonging to the IMMEX framework.

We conclude that any country seeking to increase its production for export and to successfully integrate in international production networks has much to learn from the Mexican policy experience. Under certain conditions, Mexico's experience allows firms in domestic manufacturing to increase their production for exports and allows SMEs participate in foreign markets. Nevertheless, Mexico is not the example to follow, if the main objective of other countries is to increase the use domestic inputs in their production for exports. This Mexico has clearly failed to achieve.

Chapter 3.

Regional Value Added Component in Manufacturing: Evidence from Top Exporters and Regions of the World Economy [†,**]

Abstract

This chapter analyses how the regional value added component in manufacturing evolved as result of the increasing fragmentation of production from 1990 to 2011. To this end, we decompose the final output (per manufacturing sector) from advanced and emerging economies (the top manufacturing exporters) into the value added contribution from domestic and foreign suppliers by country of origin. We also perform this analysis for all the geographical regions of the world economy (which are mostly consistent of developing economies). By relying on a new methodology proposed by Los et al. (2015) and on the multi-regional input output tables from the EORA dataset, our results indicate that, for most countries, fragmentation of production led to an increasing importance of the regional component of manufacturing value added. Only domestic firms in advanced and emerging economies producing in textiles, electronics and other manufacturing increased their network of suppliers beyond those available in their own region in a major way. The other sectors in advanced and emerging economies and most of the developing world mainly increased their regional ties as a result of increasing fragmentation. This indicates that despite significant decreases in transportation and communication costs observed in recent decade, manufacturing production has not become global but more and more regional.

Keywords: Fragmentation, Global Value Chains, World Input Output Tables, Manufacturing.

JEL codes: C67, L6, F2

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3.1 Introduction

In recent years, significant decreases in transportation and communication costs have led to an increasing fragmentation of manufacturing production, meaning that products are no longer produced in a single location, but instead are assembled from parts that are produced in many different locations, and which themselves can be produced in a fragmented way. In this new system of production, so it is argued, advanced economies specialize in the knowledge intensive activities of manufacturing (research and development activities, designing of the product, and so forth), while the less developed economies specialize in the labor intensive activities ones (mostly assembling of final goods) (Feenstra & Taylor, 2014). This fragmentation has led to an increasing trade in intermediate goods among economies, which has also been reinforced by the signing of major trade agreements (the implementation of NAFTA and the European Union), as well as well as the joining of low cost producers into the World Trade Organization (the case of China).

A large body of research indicates that a main outcome of such fragmentation of production, and the increasing trade on intermediate goods among economies, has been the emergence of what has been called Global Value Chains (GVCs) (Gereffi et al.,2005; Timmer et al., 2013; Feenstra & Taylor, 2014; Koopman et al., 2014). This concept of GVC refers to the increasing participation of foreign economies in the manufacturing production of a given country. Nowadays, more economies add value to the production of final goods in a given country. This increasing participation from foreign economies is then reflected in an increasing foreign value added contribution to the country's final manufacturing output. Nevertheless, in my view, and despite the aforementioned trends, manufacturing production is not entirely occurring at a global level but mostly taking place at the local and regional level. The value added contribution from local producers in the domestic economy usually still accounts for the largest share in the production of final output. Furthermore, most of the time, the neighboring economies of a given country (those that share the same geographical region) are precisely the economies behind the increasing foreign value added contribution observed in a country's final output. In this context, the scope for manufacturing production taking place at the global level is still limited.

A number of factors also play an important role in explaining increasing regionalization of manufacturing production. For instance, Baldwin (2006) and Baldwin & López-González (2015) have indicated that manufacturing production is organized at the regional level by means of headquarters and factories economies. Here, technologically advanced headquarter economies (such as the US, Germany and Japan) reallocate manufacturing activities to neighboring countries (factories) within their own region. They engage in supply chain trade activities with factory economies (exporting and re-importing of intermediate goods and of goods for final sale) to reduce transportation costs and to benefit from low-wages when those factory economies are also regarded as developing countries (this is the role played by most countries in South East Asia, Eastern Europe and Mexico for the case of factory Asia, factory Europe and factory NAFTA, respectively).

In addition, despite drastic reduction in information and communications costs, distance still matters for manufacturing production. According to Baldwin & López-González (2015), geographical clustering in the transportation sector is necessary since this specific sector requires key technicians and managers to travel among production stages which should be located within a short travel distance from the headquarter economy. In this context, the regional aspect of the increasing fragmentation of production highlights that one of main features of this process is not simply related to more goods crossing international border. More importantly, it highlights the importance of the international mobility of managerial and of manufacturing know-how (2nd unbundling).

In light of this situation, our research will analyze how the regional component in manufacturing value added has evolved as a result of the increasing fragmentation of production. The regional component in manufacturing value added is understood as the total value added delivered by a group of countries belonging to a specific geographical region to the production of final goods in a given economy. In order to further understand the evolution of this regional component, our research separately analyzes the trends observed in the top manufacturing exporters, and, the trends for the regions of the world economy (including those in Africa and Asia, as well as Oceania and Central and South America). By doing this, we analyze both the evolution of the regional component in the case of the advanced and emerging economies (most of the top manufacturing exporters), but also the one for the other regions of the world economy (which are mostly developing economies). Our two reference years will be 1990 and 2011. This is because the first one reflects a period where fragmentation was not widespread among countries, while in 2011 this had become a global phenomenon.

In this context, we will tackle the following research questions:

1) To what extent, has the increasing fragmentation of production affected the regional component in manufacturing value added?

2) As result of increasing fragmentation, do producers from top manufacturing economies responded in the same way as producers located in the rest of the World (developing economies)?

To meet these objectives, our research will first decompose the value of final good produced by a given country into the value added contribution from domestic and foreign producers (by country of origin). Then, to analyze the regional component in manufacturing value added in a single country, we will group the foreign value added results by country of origin into different geographical categories. Finally, this decomposition is extended to take into account the intra- and extra-regional value added component in manufacturing value added across all regions of the world economy.

Our results indicate that, as a result of increasing fragmentation, only advanced and emerging economies (in specific manufacturing sectors) faced significant incentives in increasing their network of suppliers beyond those available within their own region. Most of the developing world, however, increased their regional ties. On the other hand, our results for regions of the world economy indicate that the intra-regional component in manufacturing value added (i.e. the value added contribution from other economies belonging to the same region as the country of analysis), was already high before the fragmentation of production became a global phenomenon. As a result of increasing fragmentation, the intra-regional component simply became higher. The extra-regional component of manufacturing value added (i.e. the value added contribution from other economies belonging to the different regions than the main country of analysis) also increased but remained always lower than the corresponding intra-regional one. All those latter results, however, are also driven by factors governing the organization of production in each manufacturing sectors (type of good being produced, the modularity of its production, the proximity to major markets and the existence of significant trade and tariff incentives, and so forth).

This paper is structured as follows. Section 3.2 presents a literature review on how the fragmentation of production has evolved over time and on the different analytical tools currently available to measure such phenomenon. Section 3.3 presents our preferred methodology to decompose the value of final goods production into the different value added contributions from domestic and foreign producers (by country of origin). This section also briefly describes the EORA multi-regional input-output dataset used in our research, the strategy we follow in order to group countries according to geographical categories, as well as our method to identify the intra-regional and extra-regional value added contribution observed in a region's final output. Section 3.4 presents our decomposition results for top manufacturing exporters considering total final manufacturing output, and the production per manufacturing sector for 1990 and 2011. This section also presents the intra-regional and extra-regional results for all the regions of the world economy for the same years. Finally, Section 3.5 presents our conclusions, points for discussion and avenues for further research.

3.2 Literature Review: How Has Fragmentation Evolved and How We Can Measure It?

This literature review is divided into two sub-sections. The first one briefly summarizes the evolution of fragmentation over time, while the second one deals with an explanation of the available analytical tools to analyze this process.

3.2.1 The Evolution of the Increasing Fragmentation of Production.

The term fragmentation was first coined by Jones and Kierkowski (2001). They refer to the splitting up of a production process into two or more stages that can be undertaken in different locations. According to Athukorala (2010), the increasing fragmentation of manufacturing production has evolved through 3 different stages. The first stage is the formative. Here, only a small amount of multinational firms in few manufacturing sectors (electronics) reallocated some parts of their production to low cost economies. The main objective was to perform labor intensive parts of manufacturing abroad. This implied assembling of imported components that were supposed to be re-exported back as final manufacturing goods. The second stage in the evolution of fragmentation involved a higher participation of countries in the production network. Similarly, along with technological improvements, the production process of a great amount of manufacturing goods started becoming more prone to fragmentation. In light of this situation, multinational firms start reallocating not only the labor intensive activities to developing economies but also the knowledge and capital intensive stages of manufacturing to advanced economies. Here, the main outcome was the emergence of an increasing trade on intermediate goods between countries that has grown at higher rate than that of final manufacturing goods. Finally, the last stage in the evolution of fragmentation is related to the emergence of major low cost producers and the fragmentation of a wide range of manufacturing goods (textiles, transportation, all sort of electronics and other manufacturing goods). The main outcome behind this last stage is that some developing economies (those located in East Asia) managed to successfully abandon the labor intensive activities and start producing at the knowledge and capital intensive stages of manufacturing.

Given this context of increasing fragmentation, multinational firms face two options in order to organize manufacturing production across different countries and regions. The first option is to coordinate the production process among subsidiaries of the multinational firm located in other countries. The second option is to organize the production with other firms in the market that do not belong to the multinational firm. According to Williamson (1975), the decision of organizing the production through market transactions or within the structure of the multinational firm will depend on the specificity of manufacturing good being produced. For instance, arm's length market transactions[6] will be implemented when standard products are being produced. What we mean here is that this type of market transaction works well for those goods that are being widely produced (i.e. they are the in the mature stage of their product cycle) because their production is easy to describe and its production process is widely known and can be easily implemented by a large variety of suppliers.

On the other hand, the more customized the product or the service, the more likely it is to involve transaction specific investments that will take place within the firm (Gereffi et al., 2005). This is the case of the non-standardized inputs. In my view, there are several reasons why a firm may decide to keep the production of these goods within their own structure. The first issue is related to opportunistic behavior. Given that the production of those non-standardized inputs might have implied significant expenses on research and development activities, multinational firms are not willing to engage in market transactions with other potential competitors. This is because those potential competitors might take advantage of the knowledge and of the large expenses made by the multinational firm by replicating such intermediate inputs. The second issue is that the production of such inputs also implies greater coordination among the entities of the firm. Since the production of the new good is not highly codified, the multinational firm requires greater coordination and supervision of the new process in order to ensure that their subsidiaries correctly implement the process. Finally, the last reason why firms decide to keep transactions within their own structure in the case of the non-standardized goods is related to the cost of inducing a learning process. Firms in the market might not have the necessary skills in order to implement the production

[6] Arm's length transactions indicate that buyers and sellers of a product act independently and have no relationship with each other

process of a good according to the high standards set by the firms. Inducing a learning process for those firms in the market might be costly for the multinational so it could be a better idea to keep their activities in house.

3.2.2 How to Analyze the Increasing Fragmentation of Production?

The increasing fragmentation of manufacturing production has also created significant challenges for scholars and policymakers. There are two main challenges. The first one is that it has become difficult to determine which countries and regions benefit from the increasing fragmentation of production. Given the interaction of many countries and regions in production networks, we see that intermediate goods can cross borders between countries more than once. Furthermore, the growth rate of the trade on intermediate goods is now higher than the corresponding one for final goods. Therefore, it has been argued that policy makers and scholars cannot totally rely on standard international trade statistics to analyze the increasing fragmentation of production.

The second challenge is a better understanding of the main characteristics of the firms that participate in international production networks. Firms that participate in global value chains are heterogeneous, not only in terms of size, or in type of ownership (domestic or foreign owned). They are heterogeneous considering the type of good they produce, the type of trade benefits and incentives they receive, the export promoting schemes which they participate (export processing zones, for instance) or the type of manufacturing specialization they follow (whether they are mostly producing for exports or whether their production is also supplied to the domestic market). In general, policy makers and scholars require more complex statistical and analytical tools and a deeper understanding of how firms behave in the context of production networks in order to fully understand international production networks.

The reaction to these challenges has been the increasing use of other more elaborated analytical tools such as aggregate input output tables, multi-regional input output tables as well as micro data and case studies. We will explain each of them and how they have been used to analyze fragmentation.

The first one is the use of input output tables for the total economy of a given country (aggregate input-output tables). Hummels et al. (2001) introduced the concept of vertical specialization (VS). This index, by means of input-output tables (IOTs), calculates the imported input content in the manufacturing goods exported by an economy. This imported input content is reported by this index in a scale of 0 to 1. This analytical tool was one of the pioneering works to better analyze the fragmentation of production because it allowed determining both the foreign and domestic input content embodied in a country's export. This is because the remaining part of this index of VS (the one that is not the level of imported input content) can be regarded as a measure for the domestic input content observed in the manufacturing exports of a country.

Nonetheless, despite its usefulness in assessing the domestic and foreign value added embodied in exports, the index of vertical specialization has several shortcomings. For instance, Koopman et al. (2008) and De La Cruz et al. (2011) have criticized the underlying assumption of the original index of VS initially developed by Hummels et al.

(2001). A key assumption needed for the original formula of VS to work is that the intensity in the use of imported inputs is the same between different types of production; production for processing exports and the production for the domestic use. This assumption may not hold for economies that are highly engaged in international production networks. This is because policy preferences for firms engaged in global production networks lead to significant differences in the intensity of imported inputs (De La Cruz et al., 2011). Firms engaged in global production networks might use more imported inputs in their production for processing exports than firms that solely produce for the domestic market. Recognizing this situation, Koopman et al. (2008) posited that if a distinction between the production for processing export and the production for domestic use is not provided, then the weighted average observed in the index of VS will underestimate the share of foreign value added in a country's exports.

The second analytical tool that can be used to analyze the increasing fragmentation of production is the use of multi-regional input output tables. A multi-regional IOT is an extension of a national (aggregate) input output table. By relying on bilateral trade data, national IOT are linked across countries in order to construct a multi-regional setting of IOTs for the world economy. The multi-regional IOT disaggregates the imported goods received by a given economy (either for final or intermediate use) according to country of origin. It also indicates the domestic consumption of goods for intermediate and final use and the delivery of those goods domestically produced by county of destination. In recent years, several multi-regional IOTs have become available. Some of the most widely known databases are the Global Trade Analysis Project (GTAP) from Dimaranan et al. (2005), the EORA multi-region input output table (Lenzen et al., 2012), the World Input Output Tables (Timmer et al., 2015) and, the Trade in Value Added initiative from the OECD and WTO. The main differences among them are not only related to the number of manufacturing sectors and period of time being studied, or the amount of countries there included. More importantly, according to Tukker and Dietzenbacher (2013), the key difference between the various global input-output systems is that those were developed by following different construction philosophies.

The use of those databases has provided a great number of advantages in order to further understand the process of fragmentation. We can mention two of them. The first one is the concept of the value added exports. According to Johnson and Noguera (2012), value added exports measure the amount of value added from a given source country that is consumed in each destination (i.e., embodied in final goods absorbed in that destination). Following the aforementioned authors, at the bilateral level, the ratio of value added to gross trade is a marker for both bilateral production chains, as well as multi-country production chains in which value added transits through third countries en route from source to destination. Therefore, changes in the ratio of value added to gross trade through time are a metric for changes in the structure of cross-border supply chains. Measuring these changes is a prerequisite both for empirical work aimed at identifying the fundamental drivers of fragmentation and for calibrating models that measure the consequences of rising fragmentation.

Given such analytical context, Johnson and Noguera (2012) compute the value added content of trade for forty-two countries from 1970 to 2009. Their results indicate that, for the world, the ratio of value added to gross trade falls by ten to fifteen percentage points, with two-thirds of this decline in the last two decades. Across countries, declines range from zero to twenty-five percentage points, with large declines concentrated among countries undergoing structural transformation. Across bilateral trade partners, declines are larger for nearby partners and partners that adopt regional trade agreements. In their view, this whole context indicates that both policy and non-policy trade costs shape production fragmentation.

The second important contribution for the analysis of fragmentation that has been made possible due to the availability of multi-regional IOTs is the fact that now it is possible slice up the value chain in which a country participates. Koopman et al. (2014), for instance, break up a country's gross exports into various value added components by source and additional double counted terms. Those various added components include the domestic and foreign content that is embodied in final goods and intermediate inputs. The utility of this analytical tool is that it integrates all previous measures of vertical specialization and value-added trade in the literature into a unified framework. Following this framework, Koopman et al. (2014) break up the gross exports of various advanced and emerging economies for the reference year 2004. Their results provide evidence on relevant issues for fragmentation such as the domestic value added that returns home in terms of foreign imports, which is part of the double counting in official trade statistics.

Yet another method to slice up the value chain is that provided by Los et al. (2015). Those researchers indicate the value added contribution by country of origin in the final manufacturing production of several goods. Their analysis focuses on forty countries and fourteen manufacturing sectors. By relying on standard IOT techniques, their results indicate that in almost all product chains the share of value added outside the country is increasing since 1995. The share of value added outside the region has been increasing much faster though. These tendencies were only briefly interrupted by the financial crisis in 2008.

Nonetheless, despite the usefulness and widespread use of multiregional IOTs (and of the aforementioned IOT techniques), they are not exempt from problems. According to Nomaler and Verspagen (2014), there are several problems related to the aggregated nature of the input-output table that may lead to large distortions and biases. There are three main sources from such distortion when value chains are decomposed with IOT: the average nature of value added to output ratios in the tables, the emergence of production cycles in the process of aggregating several value chains into a single table, and the characteristic of the Leontief inverse matrix to even out the value added distribution. In this whole context, those authors suggest that more detailed sources of information should be used to better analyze the increasing fragmentation of production.

Firm-level datasets and the information provided by detailed case studies are the alternative to cope with the biases triggered by the use of aggregate data. For instance, firm-level domestic value added can be calculated the by adding up information in terms of domestic and imported intermediate inputs, wages, rental cost on capital, profits and so forth. Then, by relying on techniques such as firm demography, the domestic value added created by a given economy can be decomposed into the contribution from the firms that exit the market, those stay and so forth. Furthermore, the incorporation of firm level information into IOT settings has been proposed as the key strategy to tackle strong assumptions behind those tables as well the biases they can trigger when analyzing the fragmentation of production. According to Ahmadm and Araujo (2011), firm level data sets can improve the quality of the IOT given that they contain information for export and import intensity as well as for ownership status. This disaggregation can be then used to improve the allocation of total imports across sectors and create stronger links between imports used in exports and imports used in domestic demand.

Similarly, case studies also allow for a more comprehensive analysis of the fragmentation of production at the firm-level. Here, we are referring to study of Dedrick et al. (2010) on the Iphone and Ipad. According to those authors, while these products, including most of their components, are manufactured in China, the primary benefits go to the U.S. economy as Apple continues to keep most of its product design, software development, product management, marketing and other high-wage functions in the U.S.

Two main ideas that are relevant for the current research project emerge from this literature review. From section 3.2.1, we understand that firms will have different incentives to organize the manufacturing production across countries and regions. Those incentives are not only related to the endowments of capital, labor or knowledge available in each country, but also to the specificity of the good being produced as well as the type of market transaction that the production of this involves. From section 3.2.2, we observe that there are several methods and databases to analyze the regional component of manufacturing. Firm level datasets and case studies are by far the best alternative to analyze this given the specific and detailed information that they provide. Nevertheless, access to such information is highly limited. Therefore, to analyze fragmentation as a phenomenon impacting the World economy, our research necessarily has to rely on the information provided by multi-regional input output tables and the decomposition methods that can be implemented with those. The aggregate nature of the input-output framework and the biases they can trigger should be kept in mind when deriving conclusions from decomposition techniques. With these ideas in mind, we proceed to indicate our preferred methodology and data. This objective is met in the following lines.

3.3 Methodology and Data

The main objective of our research is to decompose the final production from a given country/ region into the value added contribution of foreign and domestic producers that participate in this production. To achieve this objective, our research will rely on the methodology proposed by Los et al. (2015). The main reason for this is that, in my view, the decomposition technique offered by those authors is more standard and straightforward than the decomposition studied by Koopman et al. (2014). Koopman et al. (2014) offer an interesting decomposition framework that unifies all the existing measures of vertical specialization and value added trade. Nevertheless, given the amount of countries and regions that we aim to analyze, our research is mostly interested in the value added contribution from foreign and domestic suppliers and not in the different value added categories that integrate those concepts.

By generalizing a measure of fragmentation proposed by Feenstra and Hanson (1999), Los et al. (2015) introduce a metric that uses information from multiregional Input Output Tables to describe the international fragmentation of specific global production networks. Specifically, Los et al. (2015) decompose the value of a final product in the last stage (country) where the final manufacturing production took place. This decomposition includes the value added shares generated in all the countries that contribute to that final product. Therefore, this measure does not only take into account the value added by the immediate suppliers of intermediates, but also the value added by suppliers further upstream.

Formally, consider a particular industry *i* located in a specific country *j*, denoted by (*i,j*). To produce good (i,j), activities in industries s=1,…,S in each of the countries n=1,…,N are needed. To decompose its value, the first step to take is to find the levels of gross output associated with the production of (i,j). Those can be estimated by applying standard input output methods to global input output tables. Global input output tables contain information on the values of intermediate input flows among all country industries in the world, as well as on the values of flows from each of these country-industries to final use in each of the countries. These tables also contain information on value added generated in each of the country industries. Combining information on value of sales and value added per dollar of sales leads to estimates of value added in each of the *SN* industries as a consequence of final demand for product (i,j). For this, the equation that has been a standard tool in input-output analysis for over decades (Miller and Blair, 2009) can be used:

$$\mathbf{g} = \hat{\mathbf{v}}(\mathbf{I} - \mathbf{A})^{-\mathbf{1}}(\mathbf{Fe}) \qquad (3.1)$$

In this equation, $\mathbf{g}$ is the vector of value added created in each of the SN country-industries involved in a value chain. The choice for a specific final output matrix $\mathbf{F}$ determines which value chain is considered. Final output is output delivered for household and government consumption, or investment demand (both including domestic and final foreign demand). $\mathbf{e}$ is a summation vector. $(\mathbf{I} - \mathbf{A})^{-\mathbf{1}}$ is the well-known Leontief inverse matrix, the use of which ensures that value added contributions in all tiers of suppliers are taken into account. $\mathbf{v}$ is a vector with value added over gross output ratios, for each of the country-industries.[7]

The (*SNxSN*)-matrix $\mathbf{A}$ and the (SN)-vector $\mathbf{v}$ are obtained as $\mathbf{A} = \mathbf{Z}(\hat{\mathbf{x}})^{-\mathbf{1}}$ and $\mathbf{v}' = \mathbf{w}'(\hat{\mathbf{x}})^{-\mathbf{1}}$, respectively. $\mathbf{A}$ gives the intermediate inputs per unit of output of gross output, while $\mathbf{v}$ represents the value added generated per unit of gross output. $\mathbf{Z}$ represents the inter-industry demand for intermediate inputs, while $\mathbf{w}$ indicates the row vector for gross value added. $\mathbf{F}$ stands for a final demand matrix of dimensions SNxCN (where C is the number of final demand categories per country) and, $\mathbf{e}$ represents a summation vector consisting of ones. $\mathbf{Fe}$ is then a (SN) vector with a single positive element, which is obtained by adding foreign and final demand for (i,j)'s product.

[7] Matrices are indicated by bold capital symbols and (column) vectors by bold lowercases. Hats denote diagonal matrices with the corresponding vector on the main diagonal.

In order to implement this methodology, a multiregional input-output framework is required. As mentioned in section 3.2.2, a number of multiregional IOTs are currently available.Given the objectives of this research, we will utilize the EORA database. The main reason for this is the extensive coverage of countries and manufacturing sectors as well as the rather long period of time covered by this database. As explained in Lenzen et al. (2013), the EORA multiregional input output database covers 187 countries in 8 manufacturing sectors during the period from 1990 to 2012. Such extensive coverage is rather useful for the scope of this research. Not only will this database allow us to focus on the top manufacturing exporters of the world economy, it will also let us perform a thorough analysis of the global tendencies from the increasing fragmentation of production by taking into account not only the context taking place in major regions (North America, Western Europe, East Asia) but also in the rest of the world. This means that EORA also lets us analyze the tendencies of fragmentation in regions such as Central America, South America, Central Asia, South East Asia, Eastern Europe, North Africa and the Middle East, Sub-Saharan Africa and, Oceania. Similarly, the years covered by this database allow us to analyze the fragmentation of production between two relevant periods. The first one being a year where fragmentation was not widespread (1990) and, the second being a year (2011) where major changes in the world economy had occurred and thus fragmentation of production was already regarded a more common strategy for manufacturing. Those changes are the signing of important regional trade agreements (MERCOSUR in 1991, NAFTA in 1994, China's accession to WTO in 2004, the accession of 10 countries to the European Union in 2004, and so forth) as well as the drastic drop in communication and trade costs.

Given that our main objective is to decompose the final production from a given countries and regions, our results will be divided in two main sub-sections. The first section will present the decomposition of value chain per manufacturing sectors for top 6 manufacturing exporters from the world economy in 2011 considering the 8 manufacturing sectors included in EORA as well as the total manufacturing output. The second sub-section will slice-up the value added chain observed in a region in terms of the intra-regional and extra-regional value added contribution embodied therein.

The top manufacturing exporters studied will be those that ranked in the top 6 according to export information provided by EORA for 2011. We sliced up the value chains of those top 6 countries for 2011 and 1990. This procedure means that the top manufacturing exporters analyzed for 1990 might not be the ones indicated by EORA in 1990 (recall that our reference year is 2011). We do this because our intention is to analyze the evolution of those manufacturing producers that managed to succeed by the end of the 2010s. Moreover, we further decompose the total foreign value added observed in each country according to the different value added contributions from regions of the world economy (Europe, North America, Central and South America, Africa, Asia and Oceania).

In this context, consider the regional value added contribution from countries i belonging to region j embodied in the final output from country k ($RVA_{i\in j,k}$) as follows:

$$RVA_{j,k} = \sum_{i\in j}^{i}(FVA_{i,k}) \qquad (3.2)$$

where $FVA_{i,k}$ is the foreign value added contribution from country i in the final manufacturing production of country k as obtained from equation 3.1.

Similarly, the total foreign value added contribution embodied in the final production from k (FVA_k) can be defined as:

$$FVA_k = \sum_j RVA_{j,k} \qquad (3.3)$$

Finally, the total value added delivered by foreign and domestic suppliers to the final production in k (TVA_k) will be

$$TVA_k = DVA_k + FVA_k \qquad (3.4)$$

where

DVA_k: The domestic value added contribution embodied in the final output from k.

On the basis of those equations, our research will determine patterns for the regional component of manufacturing for a given country. If we observe an increase in the $RVA_{j,k}$ in the region to which country k belongs (i.e where $\in j$) , we will conclude that there is an increasing regionalization of manufacturing of production for country k. In this case, domestic producers will be interacting more with suppliers within their own region. On the other hand, if we observe an increase in the $RVA_{j,k}$ for regions where country k does not belong (i.e where $k \notin j$), our research will conclude that there is an increasing globalization of manufacturing production for country k. In this case, domestic producers will be interacting more with suppliers outside their own region. Finally, it is worth mentioning that in this first sub-section, the geographical regions of analysis (i.e., region j that interacts with country k) will be Europe, North America (NAFTA), Central and South America, Africa, Asia and Oceania. This grouping of countries is possible due to the large amount of countries considered by the EORA dataset.

The second sub-section will slice up the value chain in a manufacturing sector for regions from the world economy. This means that we identify a region of the world economy and then we slice up the value added contribution embodied in the final manufacturing production of that region. In this case, the value added embodied in the final production from a given region is sliced up into two main components: the intra-regional value added contribution, and the extra-regional value added contribution. The intra-regional value added contribution will be the sum of the domestic value added embodied in the final good produced by each country and the value added delivered by other countries within the same geographical region as reported by the main country of analysis. The extra-regional value added contribution will be the sum of the foreign value added contribution from other countries belonging to different regions, as reported by countries belonging to the main region of analysis. Formally, the intra-regional value added contribution embodied in a given region j ($IRVA_j$), the corresponding extra-regional value added contribution ($ERVA_j$), as well as the total value added embodied in such region ($TVAR_j$) can be defined as follows:

$$IRVA_j = \sum_{k\in j}^{k}\left(DVA_{k\in j} + FVA_{i\in j,k}\right) \qquad (5)$$

where:

$DVA_{k\in j}$: Domestic value added in country *k* that belongs to region *j,*

$FVA_{i\in j,k}$*:* Foreign value added contribution from country *i* belonging to region *j* as reported by country *k.*

$$ERVA_j = \sum_{k\in j}^{k}\left(FVA_{l\notin j,k}\right) \qquad (6)$$

where:

$FVA_{l\notin j,k}$: Foreign value added contribution from country *l* not belonging to region *j* as reported by country *k*.

Finally, the total value added embodied in the final production from a given region *j* will be:

$$TVAR_j = IRVA_j + ERVA_j \qquad (7)$$

This method of computing the intra-regional and extra-regional value added contribution embodied in region j will be performed for all the regions of the world economy. To this end, we will follow the country categories proposed by UNIDO (2015) on the industrial development report for such year. This means that we will analyze the following regions: North America, Central America, South America, Western Europe, Eastern Europe, North Africa and the Middle East, Sub-Saharan Africa, Central Asia, South Asia, South East Asia, East Asia, and Oceania.

3.4 Results.

As previously mentioned, we will first focus on the value chain decomposition from the top manufacturing exporters and, later with the decomposition observed in the intra-regional and extra-regional value added embodied in a region's final output. Therefore, section 3.4.1 and 3.4.2 will present the results we obtained by following equation (3.1) to (3.4) using the EORA data set. Section 3.4.3 will present the results we obtained relying on equation (3.1) and following equation (3.5) to (3.7) with the same dataset.

3.4.1 Top Manufacturing Exporters.

Our decomposition results for the top manufacturing exporters from each country category included in EORA follow a general tendency. When our two reference years are compared (1990 and 2011), we observe a decline in the domestic value added contribution and an increase in the foreign value added contribution. This trend empirically confirms the increasing fragmentation of production across countries and manufacturing sectors. Yet another important idea that can be inferred from our results is the fact that the organization of manufacturing production across different countries and manufacturing categories is mostly regional. This means that the increase in the foreign value added contribution from most countries (in most of the manufacturing sectors) is related to an increase in the participation of countries inside the region being analyzed (i.e. the region where our reference country belongs). For instance, in the case of Canada, the countries responsible for the increasing foreign value added embodied in its final output are mainly Mexico and the United States (their closest neighbors belonging to the North American region) with very few increases from countries outside the region. Below, we will further analyze and present details of how these regional tendencies work, considering total final manufacturing production as well as different product categories. As we will see, very few countries in very few manufacturing actually showed a tendency where the foreign value added from outside the region (extra-regional value added) was higher than the one produced inside the region.

3. 4.2 Final Manufacturing Output.

Table 3.1 presents our results for the top manufacturing exporters considering the production of total final output. Table 3.1 (and the tables presented in section 3.4.3) indicates the share of domestic and total foreign value added in final manufacturing output. The total foreign value added contribution is further decomposed according to region of origin. Here, we show the share of a region's value added in the final output as reported by the country of analysis.[8]

Table (3. 1):Share of Value Added Contribution in Final Output (%). Total Final Manufacturing Production.

1990

Country	Foreign Value added (FVA)						Total FVA	Domestic Value Added (DVA)	FVA+DVA
	EUROPE	NAFTA	C.S. America*	Africa	Asia	Oceania			
Germany	14	2	0	0	3	0	20	80	100
USA	4	3	1	0	3	0	11	89	100
Japan	3	3	0	0	2	1	9	91	100
Italy	15	2	0	1	2	0	21	79	100
China	3	2	0	0	4	0	9	91	100
Mexico	4	12	1	0	2	0	19	81	100

2011

Country	Foreign Value added (FVA)						Total FVA	Domestic Value Added (DVA)	FVA+DVA
	EUROPE	NAFTA	C.S. America*	Africa	Asia	Oceania			
Germany	20	3	1	1	7	0	32	68	100
USA	6	5	2	1	6	0	20	80	100
Japan	4	3	1	0	7	1	16	84	100
Italy	21	2	1	1	6	0	33	67	100
China	6	2	1	1	8	1	19	81	100
Mexico	7	13	2	0	6	0	29	71	100

Source: Author's calculation based on equation (3.1) to (3.4) and using EORA data set. (*) Indicates Central and South America. Due to rounding, shares might not add up to the total. Refer to appendix A3.1 for further details on these tables.

[8] The interested reader should refer to the appendix A3.1 to identify the share of foreign of value added contribution by specific country of origin in each of the results for the top manufacturing exporters. Detailed information is provided both for final manufacturing production as well as for each manufacturing sector included in EORA.

By comparing the foreign value added (FVA) and the domestic value added (DVA) results from 1990 to 2011, we realize that on average the DVA in total final output for each country was reduced by 10%. This reduction made room for an increase in the FVA. Nonetheless, by analyzing our base year (1990), we realize that a significant regional component in the FVA from each country was already present. By 1990 the largest contributors to the FVA in a given country were already the neighboring economies from such countries. So, as a result of the increasing fragmentation production, the regional interaction between countries became stronger, leading to a higher FVA.

Of our top manufacturing exporters in total final output, those that completely followed a pattern of higher regional interaction as a result of fragmentation were Germany, Italy, China and Mexico. For these countries, the foreign value added from other countries belonging to their same region accounted for at least half of the total FVA embodied in their output. All these countries also saw an increase in the value added outside the region between 1990 and 2011, but this increase never resulted in value added shares higher than the regional value added delivered by their neighbors. The United States and Japan followed a somewhat different pattern. For instance, in 1990, the regional value added from Asian countries in US final output was quite similar to that from NAFTA, both of them, however, being lower than the European share. The increasing fragmentation of production led to a higher interaction of the US with its NAFTA neighbors by 2011. Nevertheless, despite the increases of NAFTA value added in US exports, the share remained smaller than value added from Asia and Europe. In the case of Japan, by 1990, this country had a diversified regional value added structure similar to that of the United States in 1990. In the initial year, the value added from Europe and NAFTA embodied in Japanese exports was higher than the corresponding one from Asia. Nevertheless, unlike the case of the US in 2011, the increasing fragmentation of production led Japan to more strongly interact with countries within their own region. The result of this was that the value added from Asia in Japanese exports was finally higher than the one from Europe and NAFTA.

The cases of Japan and the United States illustrate an interesting issue in the fragmentation of production. During the early 1990s, Japan and the United States were already considered global manufacturing powers given that their firms were leaders in productivity, innovation and so forth. Thus, to maintain high competitive levels, those global manufacturing powers in Japan and the United States had to rely on the efficiency of other production networks not located within their region. In my view, this is the reason why by 1990 those countries had a such diversified regional value added structure. Then, as a result of the increasing fragmentation of production, the manufacturing capabilities of the neighbors from Japan and the US significantly increased, leading to higher value added contributions to their neighbors. Nevertheless, in the case of Japan, stronger regionalization was observed because a number of Asian countries became highly competitive. Furthermore, it is usually argued that Japan gave up some manufacturing production at the expense of the industrial emergence of China. In the case of the US, the manufacturing capabilities from its neighbors increased but not as much as in Asia. This is the special case of Mexico that has not successfully achieved a process of industrial upgrading that leads to a higher domestic production of intermediate goods. Finally, yet another reason for the stronger regionalization of production in the case of Japan, when compared to the US, is simply the fact that Japan has more neighbors within its region. This is the main reason why the US will not drastically increase their regional (NAFTA) value added when compared to Asia and Europe (at least not when considering the total final manufacturing output).

3.4.3 Final Production per Manufacturing Sectors.

Let us now focus in the value chain decomposition for the top 6 manufacturing exporters in each of the manufacturing sectors included in EORA. For each sector we will try to provide the specific reasons as to why there is a higher regionalization or higher globalization of manufacturing production.

3.4.3.1 Food and Beverages.

Table 3.2 presents our results for the Food and Beverages sector. In this case, most of the top manufacturing exporters in this product category experienced a strong regionalization of their manufacturing production.

Table (3. 2): Share of Value Added in Final Output (%). Food & Beverages

1990

Country	Foreign Value added (FVA)						Total FVA	Domestic Value Added (DVA)	FVA+DVA
	EUROPE	NAFTA	C.S. America*	Africa	Asia	Oceania			
France	13	2	0	1	2	0	18	82	100
Netherlands	21	3	1	1	3	0	30	70	100
Germany	11	2	1	1	2	0	17	83	100
USA	3	3	1	0	1	0	9	91	100
China	2	2	0	0	2	0	6	94	100
Italy	11	1	0	1	1	0	15	85	100

2011

Country	Foreign Value added (FVA)						Total FVA	Domestic Value Added (DVA)	FVA+DVA
	EUROPE	NAFTA	C.S. America*	Africa	Asia	Oceania			
France	14	2	1	1	3	0	22	78	100
Netherlands	27	4	3	2	8	1	44	56	100
Germany	18	2	2	1	5	1	29	71	100
USA	4	5	2	0	3	0	15	85	100
China	3	1	0	0	4	0	9	91	100
Italy	17	2	1	1	4	0	25	75	100

Source: As described in Table 3.1.

The reasons for such strong regionalization are related to some specific features of this product category. In the food and beverages industry, most of the intermediate inputs have to be sourced from domestic agricultural production. The immediate processing required for most of those intermediate inputs and the relatively high non-tariff barriers usually imposed on food products also account for this (Lee and Swagel, 1997). Global retailers in the food industry have also imposed high standards for the domestic agricultural production. In order for local food producers to participate in the production network of global retailers, they have to meet high standards in terms of food safety (particularly pesticides residues and conditions for post-harvest processing), tight delivery times and, in some cases, even environmental and labor standards (Gereffi et al., 2005).

Considering this specific case from our top exporters in food & beverages, there is yet another reason for the strong regionalization in this product category. This is related to the policy incentives that most of those countries receive within their own region. For instance, countries like France, Netherlands, Germany, and Italy highly benefit from the subsidies from the Common Agricultural Policy in the European Union, while the United States has benefited from subsidies within NAFTA. In this context, we can argue that factors such as immediate processing, high non-tariff barriers, regional incentives and so forth limit the scope for further fragmentation within this industry (and, thus of higher globalization of manufacturing production).

3.4.3.2 Textiles and Wearing Apparel.

Table 3.3 presents the decomposition in textiles and wearing apparel. The main tendency observed in this table is that most of the top manufacturing exporters belong to the Asian region. Just like the previous cases, we see that each of the countries considered in table 3.3 also have a higher interaction with suppliers within their own region with respect to those located outside their region. However, something that is worth mentioning is that for other countries such as Italy and Turkey, the second largest regional value added component is Asia. This situation is important given that it indicates the importance of Asian producers for other top manufacturing exporters.

In general, there are several reasons for the increasing regionalization of textile production and for relative importance of Asian firms relative to other producers. The production networks within this industry have been greatly affected by the existence of different trade agreements. For instance, according to Gereffi et al. (2005) US import quotas established by the Multi-fiber Arrangement (MFA) fueled the spread of global production networks in apparel during the 1970s. The existence of quotas prompted the rise of value-chains intermediaries in East Asia to coordinate the flow of orders from US and European buyers to a large number of factories established around the world. Once the MFA expired by 2005, global apparel production became more concentrated among the most capable firms located in major low cost producers (China, Mexico, India, Indonesia and Turkey) (Gereffi and Memodovic, 2003).

In light of the industrial emergence of those countries, some trade agreements have imposed rather strict rules of origin in some specific textile product categories. The main idea here is to protect the domestic and regional production of textiles from the increasing competition of major low cost producers. This is the case for the NAFTA that strictly protects the cotton industry. Given the abundance of cotton within this region, in order to obtain tariff exemptions, NAFTA requires firms to develop the whole productive process in a NAFTA country using NAFTA inputs (fiber forward). Nonetheless, NAFTA is quite flexible in the textile production of goods that are not abundant in the region (linen, silk and so forth) requiring firms only to assemble the textile good in NAFTA country in order to obtain tariff exemptions.

Table (3. 3): Share of Value Added in Final Output (%). Textiles and Wearing Apparel.

Textiles and Wearing Apparel 1990

Country	Foreign Value added (FVA)						Total FVA	Domestic Value Added (DVA)	FVA+DVA
	EUROPE	NAFTA	C.S. America*	Africa	Asia	Oceania			
China	3	2	0	0	4	0	10	90	100
Italy	14	1	0	1	3	0	21	79	100
India	3	1	0	0	2	0	6	94	100
Japan	4	3	0	0	3	1	11	89	100
Turkey	11	1	0	0	2	0	14	86	100
Indonesia	6	4	0	0	10	2	23	77	100

Textiles and Wearing Apparel 2011

Country	Foreign Value added (FVA)						Total FVA	Domestic Value Added (DVA)	FVA+DVA
	EUROPE	NAFTA	C.S. America*	Africa	Asia	Oceania			
China	4	2	0	0	7	1	14	86	100
Italy	20	2	1	2	9	0	33	67	100
India	5	2	0	0	6	1	14	86	100
Japan	5	2	0	0	10	1	18	82	100
Turkey	21	2	1	1	8	0	33	67	100
Indonesia	4	2	0	0	11	1	20	80	100

Source: As described in Table 3.1.

Finally, global retailers also have a significant impact on the organization of production networks within the textile and apparel industry. Given the high modularity of this industry and the existence of major low cost producers, large retailers such as Wal-Mart can control and coordinate the production network by exercising their market power. This means that they are able to select their suppliers and control the production process until they reach final consumers. So, as we can see there has been an increasing tendency in the production of textiles to rely both on the regional networks of neighboring countries but also in the networks from Asia given the efficiency of the suppliers located there.

3.4.3.3 Wood and Paper.

The regional pattern in the value added contribution from top exporters of Wood and Paper is presented in table 3.4. In this table, we see that domestic producers in China and in the United States rely on European suppliers for the production of this good as much as they rely on the producers from their own region. This was observed both in 1990 and 2011. In my view, the reason why those major producers depend both on the network of neighboring economies and on the regional value added from one specific region is related to how the furniture sector is globally organized.

Table (3. 4): Share of Value Added in Final Output (%). Wood and Paper.

1990

Country	Foreign Value added (FVA)						Total FVA	Domestic Value Added (DVA)	FVA+DVA
	EUROPE	NAFTA	C.S. America*	Africa	Asia	Oceania			
China	2	2	0	0	3	0	7	93	100
Germany	12	2	0	0	1	0	15	85	100
UK	15	3	0	0	2	0	21	79	100
USA	3	3	1	0	1	0	9	91	100
Italy	15	2	0	1	2	0	19	81	100
France	15	2	0	1	2	0	20	80	100

2011

Country	Foreign Value added (FVA)						Total FVA	Domestic Value Added (DVA)	FVA+DVA
	EUROPE	NAFTA	C.S. America*	Africa	Asia	Oceania			
China	6	2	1	1	7	1	17	83	100
Germany	18	2	1	1	3	0	24	76	100
UK	20	4	1	1	5	0	30	70	100
USA	5	5	2	0	3	0	16	84	100
Italy	21	2	1	1	5	0	30	70	100
France	17	2	1	1	3	0	24	76	100

Source: As described in Table 3.1.

According to Kaplinsky et al. (2003), furniture has traditionally been a resource- and labour-intensive industry that includes both local craft-based firms and large volume producers. The mass production of furniture became a viable manufacturing strategy with the advent of flat-pack or ready-to-assemble designed furniture. The aforementioned authors also indicate that this product innovation paved the way for firms to design, manufacture and ship products in large quantities. Firms that mass-produce flat-pack furniture tend to supply products for the low- to medium-price markets. Solid wood furniture manufacturers have retained important niche market segments primarily for high-end, expensive and design-led products. These specialized products tend to be purchased locally while mass-produced, large-volume products are sold locally and for export. So, in this whole context, we can see that there are two main tendencies in order to organize the production of furniture. The production will tend to be local and regional in the case of flat-pack furniture (wardrobes, desks, dining tables, chairs, etc.). This is because those goods are of large size and need to be supplied close to final markets in order to avoid significant transport costs. On the other hand, the production of furniture can be global in the case of the furniture with high modularity (that can be easily assembled by the final consumer) and in the case of those expensive and designed-led products (the quality matters for the final consumer). As can be inferred, the major industry in wood production (furniture) requires the coordination of domestic producers with suppliers within the region and with suppliers outside the region depending on different product categories. In my view, this is the main reason why US and Chinese producers rely on European suppliers as much as they do for their neighbouring suppliers. For instance, European suppliers might be important in the Chinese and US production of expensive and designed-led products, while regional suppliers might be more important for the production of low-cost and large volume furniture.

3.4.3.4 Metal Products and Chemical Sector.

Following the same stream of ideas, Table 3.5 and Table 3.6 presents the results for the Metal Products and the Petroleum, Chemical and Non-Metallic Mineral Products industry, respectively. We will jointly analyse these industries because they both provide raw materials and inputs for other many manufacturing sectors. For instance, the steel industry produces important inputs for car manufacturers, while the chemical industry produces plastics and rubbers. Nonetheless, as it is confirmed by table 3.5 and table 3.6, the scope for fragmentation within those industry remains limited. Both table 3.5 and table 3.6 indicate that most of the top manufacturing producers in each industry mostly depend on the production of their domestic and regional suppliers. From 1990 to 2011, the interaction with domestic suppliers was reduced at the expense of higher interaction with regional suppliers (as it is observed by the higher intra-regional value added). According to the De Backer and Miroudot (2013), this is related to the complexity in the organization of production networks within those industries. This is because their development implies large expenditures on research & development activities, as well as high costs on safety and in transportation costs. Furthermore, in the case of pharmaceutical (chemical industry) other factors such as marketing investments as well as the different product variants, branding, adapted packaging, small volumes, should be taken into account.

Both in the case of table 3.5 and table 3.6, we realized that the production from the United States in those industries is the only one where domestic producers interact more with suppliers in other regions of the world economy than with producers in the own region. This tendency has been present since 1990 and has remained relatively unaltered until 2011. For instance, by 1990 the producers in the US metal industry already relied more on European producers rather than those located in Mexico or Canada. As a result of the increasing fragmentation of production, producers in the metal industry relied more on European and Asian suppliers and, to a lesser extent in NAFTA producers (Canada and Mexico).A similar situation occurs in the case of the production of chemicals in the US. In this case, the interaction of US producers with foreign suppliers was already diversified by 1990. This means that in that year the interaction of the US chemical industry with suppliers in Europe was as high as with Mexico and Canada. Mexican and Canadian suppliers increased their interaction with US chemical producers by 2011. However, the region that in 2011 interacted as much with US as Canada and Mexico, was Central and South America.

Table (3. 5): Share of Value Added in Final Output (%). Metal Products.

1990

Country	Foreign Value added (FVA)						Total FVA	Domestic Value Added (DVA)	FVA+DVA
	EUROPE	NAFTA	C.S. America*	Africa	Asia	Oceania			
China	2	1	1	0	3	1	8	92	100
Germany	14	2	1	1	2	0	19	81	100
Italy	15	1	0	1	2	0	20	80	100
USA	5	2	1	0	2	0	10	90	100
Japan	3	2	1	1	3	1	10	90	100
France	19	2	0	1	2	0	24	76	100

2011

Country	Foreign Value added (FVA)						Total FVA	Domestic Value Added (DVA)	FVA+DVA
	EUROPE	NAFTA	C.S. America*	Africa	Asia	Oceania			
China	5	2	2	1	8	2	19	81	100
Germany	19	3	1	1	5	0	30	70	100
Italy	21	2	1	1	5	0	31	69	100
USA	7	4	2	1	5	0	18	82	100
Japan	4	3	2	1	8	3	21	79	100
France	20	2	1	1	4	0	29	71	100

Source: As described in Table 3.1.

Table (3. 6): Share of Value Added in Final Output (%). Petroleum, Chemical and Non-Metallic Mineral Products.

1990

Country	Foreign Value added (FVA)						Total FVA	Domestic Value Added (DVA)	FVA+DVA
	EUROPE	NAFTA	C.S. America*	Africa	Asia	Oceania			
Germany	16	2	0	1	3	0	23	77	100
USA	4	4	3	1	2	0	15	85	100
France	22	3	0	4	3	0	32	68	100
China	3	2	0	0	3	0	8	92	100
Italy	19	2	0	2	3	0	26	74	100
UK	14	3	0	1	2	0	20	80	100

2011

Country	Foreign Value added (FVA)						Total FVA	Domestic Value Added (DVA)	FVA+DVA
	EUROPE	NAFTA	C.S. America*	Africa	Asia	Oceania			
Germany	24	3	1	2	6	0	36	64	100
USA	5	7	7	2	5	0	26	74	100
France	25	3	1	5	6	0	39	61	100
China	6	2	1	1	7	1	17	83	100
Italy	26	3	1	3	7	0	41	59	100
UK	18	4	1	1	5	0	30	70	100

Source: As described in Table 3.1.

3.4.3.5 Electrical and Machinery Products.

Table 3.7 presents the results for electrical and machinery products. Just like in the case of textiles, all of the top manufacturing producers at the electronics industry increased their interaction both with suppliers within their own region as well as with suppliers located in East Asia. The interaction of domestic suppliers with countries within their own region was in most cases higher than with East Asia both in 1990 and 2011. Nevertheless, the interesting thing to be noticed from table 3.7 is the fact that the top manufacturing exporters in the electronic industry increased their interaction with regional suppliers to the same extent as they increased their interaction with East Asia. For instance, from table 3.7, we notice that Germany and the UK increased their interaction with European suppliers by 5% from 1990 to 2011. During the same period, both countries increased their interaction with Asian suppliers by 4%. A special case is France that increased its network with European suppliers by 1% and with Asian suppliers by 3% during the same period of time. For the case of the US, producers in this industry increased their interaction with Asian suppliers at the expense of lower interaction with Europe. The interaction from the US with Mexico and Canada remained basically unaltered (1% increased from 1990 to 2011).

Table (3. 7): Share of Value Added in Final Output (%). Electrical and Machinery.

1990

Country	Foreign Value added (FVA)						Total FVA	Domestic Value Added (DVA)	FVA+DVA
	EUROPE	NAFTA	C.S. America*	Africa	Asia	Oceania			
China	4	3	0	0	5	0	12	88	100
Germany	11	2	0	0	3	0	17	83	100
USA	4	2	1	0	3	0	9	91	100
Japan	3	3	0	0	2	0	9	91	100
UK	14	5	0	0	5	0	25	75	100
France	18	3	0	1	4	0	25	75	100

2011

Country	Foreign Value added (FVA)						Total FVA	Domestic Value Added (DVA)	FVA+DVA
	EUROPE	NAFTA	C.S. America*	Africa	Asia	Oceania			
China	8	3	1	1	12	1	26	74	100
Germany	16	3	1	1	7	0	27	73	100
USA	6	3	1	0	7	0	18	82	100
Japan	4	3	0	0	7	1	15	85	100
UK	19	5	1	1	9	0	35	65	100
France	19	3	1	1	7	0	30	70	100

Source: As described in Table 3.1.

There are two main reasons why the increasing fragmentation of production within the electrical machinery industry allowed for a higher interaction of domestic suppliers with East Asian producers. The first one is related to the high modularity of electronics which enables activities to be undertaken across large distances. Most electronic products are characterized by high value to weight ratios resulting in the rapid and rather inexpensive delivery of intermediate and final electronic products across the globe. The coordination between the different production stages across different countries is largely done via the Internet allowing for a smooth sharing and monitoring of information (De Backer and Miroudot, 2013). The second reason is related to the continuous technological development within this industry. Here, we refer to the fact that the standardization, codification and computerization of production have allowed for a large interoperability of parts and components which in turn allows for the fragmentation of the production process across different stages (De Backer and Miroudot, 2013). The main outcome of this is that firms in the electronics industry can source their intermediate inputs from local and regional suppliers but also from other international suppliers. Due to the significant decreases in transportation and communication costs, those international suppliers can be located far away from the point of assembly (for instance, a Chinese supplier can easily deliver intermediates to producers in the US). Nonetheless, one important thing to keep in mind is that despite the high modularity observed in the electronics industry, not necessarily all firms within this industry will opt for the cheapest (and more efficient) international producer located far away. Those firms producing electronics goods of large size (freezers, flat-screens, heaters and so forth) will opt for local and regional suppliers due to the high transportation costs of exporting such final manufacturing goods. The flexibility in choosing the most efficient supplier located far away will be possible for those firms producing electronic goods of small size (tablets, cell phones, laptops and so forth).

3.4.3.6 Transport Equipment Sector.

The results for the decomposition of the transport equipment sector are presented in table 3.8. Here, most of the top manufacturing exporters show a rather high regionalization of production in their foreign value added decomposition. The interaction of the top manufacturing exporters with their network of regional suppliers was not significantly altered due to expansion of Asian suppliers in the years here considered. For instance, German manufacturers increased their network with other European producers by 7%. The interaction of Mexican and Canadian manufacturers with their respective North American counterparts remained basically unaltered.

There are several reasons why the production of this industry is organized in the context of regional production networks. The first reason is related to the cost of transportation. High transportation costs make intercontinental shipping very costly especially in downstream activities, e.g. complete cars or subsystems. According to De Backer and Miroudot (2013), political pressure may also motivate lead firms in the transport sector to locate production close to end markets; the high cost and visibility of automotive products can create the risk of a political backlash if imported vehicles become too large a share of total vehicles sold. This in turn creates pressure for supplier co-location within regional production systems for operational reasons, such as just-in-time production, design collaboration and the support of globally produced vehicle platforms (Van Biesebroeck and Sturgeon, 2010). As a result, the supplier network in the motor vehicles' industry consists of a large number of suppliers, some of them pure local suppliers (typically lower tier suppliers), others global suppliers with a local presence (top tier suppliers).

Table (3. 8): Share of Value Added in Final Output (%). Transport Equipment.

1990

Country	Foreign Value added (FVA)						Total FVA	Domestic Value Added (DVA)	FVA+DVA
	EUROPE	NAFTA	C.S. America*	Africa	Asia	Oceania			
Germany	18	3	0	0	3	0	25	75	100
Japan	3	3	0	0	2	0	9	91	100
Mexico	6	19	1	0	4	0	30	70	100
Canada	6	28	1	0	6	0	41	59	100
South Korea	8	6	0	0	13	1	28	72	100
India	4	1	0	0	2	0	8	92	100

2011

Country	Foreign Value added (FVA)						Total FVA	Domestic Value Added (DVA)	FVA+DVA
	EUROPE	NAFTA	C.S. America*	Africa	Asia	Oceania			
Germany	25	3	1	1	7	0	37	63	100
Japan	3	3	0	0	7	1	14	86	100
Mexico	9	17	3	0	9	0	38	62	100
Canada	8	28	1	0	9	0	46	54	100
South Korea	10	5	1	1	19	1	36	64	100
India	9	2	1	1	8	1	21	79	100

Source: As described in Table 3.1.

Trade and tariff incentives are another reason why the production of the transport sector is organized in regional production networks. This is the particular case of NAFTA that strongly protects regional NAFTA producers from non NAFTA producers. In order to receive trade and tariff incentives, firms in the transport sector located in North American region must meet very high regional content requirements (at least 60% of intermediate inputs used in their production must be of NAFTA origin). Finally, the last important reason for the existence of regional production networks is the hierarchical structure governing the transport production sector, which demands strong cooperation and communication between firms. The value chain of motor vehicles is largely organized through a hierarchical structure, with the large automotive manufacturers positioned on top of the pyramid as lead firms responsible for design, branding, and final assembly. One level down, first-tier suppliers produce complete subsystems by cooperating with a large network of lower tier suppliers and subcontractors. Close relationships have developed especially between car assemblers and first tier suppliers as these last ones have taken up a larger role in the whole production process, including design (De Backer and Miroudot,2013).

3.4.3.7 Other Manufacturing.

Finally, table 3.9 presents the results for the decomposition of other manufacturing goods. In this case, as a result of the increasing fragmentation of production, the domestic producers considered in table 3.9 saw an increasing interaction with their network of regional suppliers and with those suppliers located outside their region. An interesting case is that of China that increased its interaction with Asian and European suppliers to the same extent (3%) during the twenty years considered. European producers, such as Germany and Italy, also increased their network with suppliers outside their region as much as they did with suppliers located in the same region. Canada and the United show a similar pattern, while Thailand became progressively more integrated with Asian suppliers.

Table (3. 9): Share of Value Added in Final Output (%). Other Manufacturing.

1990

Country	Foreign Value added (FVA)						Total FVA	Domestic Value Added (DVA)	FVA+DVA
	EUROPE	NAFTA	C.S. America*	Africa	Asia	Oceania			
China	3	3	0	0	4	0	10	90	100
Italy	17	2	0	1	2	0	22	78	100
Germany	13	2	0	0	3	0	18	82	100
USA	4	3	1	0	3	0	10	90	100
Canada	3	9	0	0	2	0	14	86	100
Thailand	12	5	1	0	13	1	33	67	100

2011

Country	Foreign Value added (FVA)						Total FVA	Domestic Value Added (DVA)	FVA+DVA
	EUROPE	NAFTA	C.S. America*	Africa	Asia	Oceania			
China	6	2	1	1	7	1	17	83	100
Italy	24	2	1	2	7	0	36	64	100
Germany	19	2	1	1	8	0	31	69	100
USA	5	5	2	1	6	0	19	81	100
Canada	4	9	1	0	4	0	19	81	100
Thailand	12	4	1	1	25	2	46	54	100

Source: As described in Table 3.1.

Just like the case of electronics and textiles, the modularity in the production of other manufacturing goods allows for this tendency where domestic producers can equally opt for suppliers located inside their region as well as those located far away. The fact that this industry is also globally organized by major multinational firms (such as the ones in the toy sector) also explains why domestic producers are able to seek for low cost and efficient suppliers outside their own region. Having thoroughly discussed the decomposition results per manufacturing sectors for the top manufacturing exporters, we will now present and discuss the results for the regions of the world economy.

3. 4.4 Results for the Regions of the World Economy.

Our decomposition results for the regions of the world economy are summarized in figure 3.1a and figure 3.1b. The first figure indicates the results for 1990, while the second indicates those for 2011. Both figures refer to the decomposition results considering the total final manufacturing production produced by each region. Let us further explain the intuition behind these figures. The size of the bubbles represents the total value added generated inside a region in the production of final manufacturing goods. The total value added generated in each region is equal to the sum of the intra-regional and extra-regional value added (see equation 3.7). The number in, or next to, a bubble (in black or white) indicates the share of manufacturing value added generated within the region for the production of final output (i.e. the intra-regional value added). Arrows show the main sources of value added coming from other regions (i.e. the extra-regional value added embodied in the total final value added generated by a given region). Red numbers indicate the percentage of extra-regional value added that came from these transactions in the region's total manufacturing value added. Finally, letters in orange located close to a bubble indicate the specific name from the main region of analysis (refer to notes located below figure 3.1a).

Figures 3.1 and 3.2 only indicate the cases where the extra-regional value added embodied in final output was higher than 5%. Detailed information about the specific sources of extra-regional value added in a region's total manufacturing production, in the 8 manufacturing sectors considered by EORA, for each of the regions of the World economy (both for 1990 and 2011) is presented in the appendix A3.2.

In order to further understand the reasoning behind figure 3.1a and figure 3.1b let us provide one example. Consider the case of the regional final manufacturing output produced by Central America in 1990 in figure 3.1a. In 1990 the intra-regional value added in the total production from Central America was of 72%. Producers in Central America largely interacted with suppliers in North America. Mexico, Canada and the US contributed 15% of total value added of Central American final goods production. Suppliers in Europe also interacted with Central American manufacturers, but to a much less extent than this region did with North America (6%).

We now proceed to indicate the general trends observed in figure 3.1a and figure 3.1b. Most of the regions of the world economy experienced a decrease in their intra-regional value added from 1990 to 2011. In general, intra-regional value added decreased by 5%. The region that experienced the highest drop in its intra-regional value added is South Asia (a drop of 10% from 1990 to 2011). This drop occurred at the expense of a higher interaction of this region with European suppliers. In my view, the main reason for this large drop is the fact that some of the major low cost producers of the World economy (especially in the production of textiles) belong to this region. We are referring to India, Pakistan and Bangladesh. The lower level of intra-regional value added at the expense of a higher extra-regional value added simply implies that domestic manufacturers in those three South Asian countries increased their interaction with firms located in Europe. Even though the individual contribution from each sub-region in Asia is lower than 5% for the total value added in South Asia (and therefore no arrows are included in figure 3.1a and 3.1b), the joint contribution from Central Asia, East Asia and South East Asia is a little higher than 5%.

This situation indicates that the competitive pressures faced by major South Asian low cost producers pushed them to increase their network with European suppliers but also from those located in other regions in Asia.

Figure (3. 1): Intra-Regional and Extra-Regional Value Added Embodied in a Region's Total Final Manufacturing Output, 1990 and 2011.

Figure 3.1a: 1990

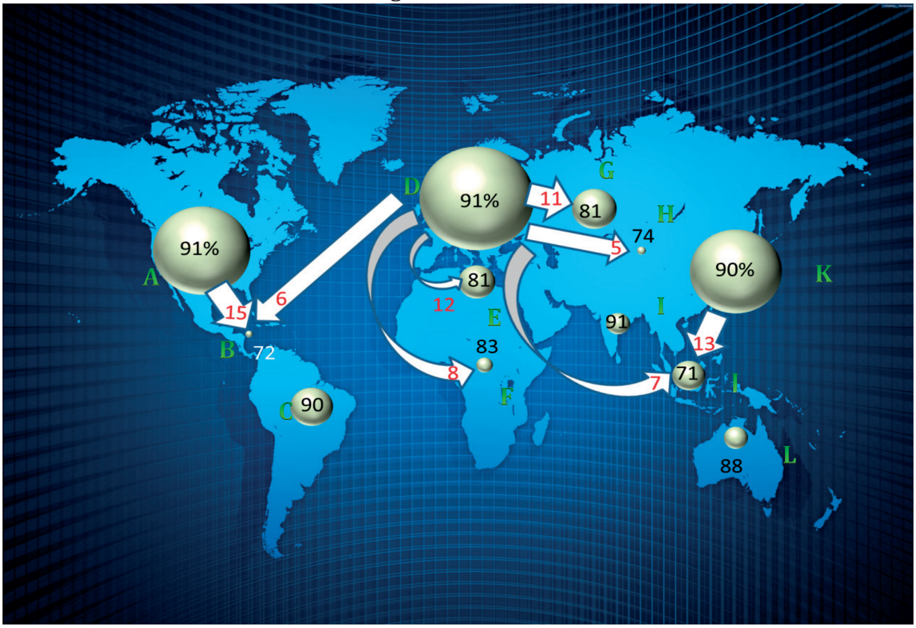
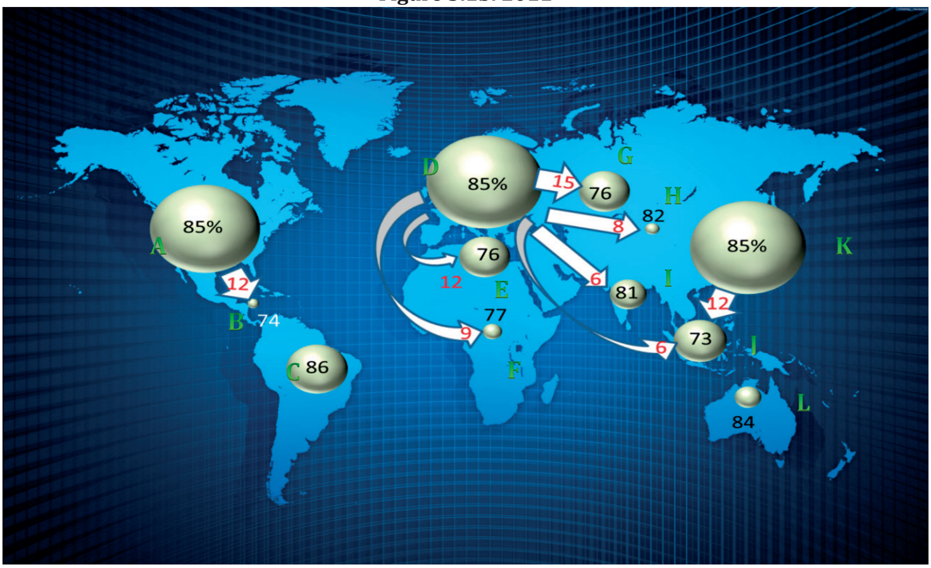


Figure 3.1b: 2011



Source: Author's calculation based on equation (3.1) for the value added decomposition and, equation (3.5) to (3.6) for the inter-regional and extra-regional value added contribution, respectively. Geographic country categories as proposed by UNIDO (2015). **A:** North America, **B:** Central America, **C:** South America, **D:** Western Europe, **E:** North Africa and the Middle East, **F:** Sub-Saharan Africa, **G:** Eastern Europe, **H:** Central Asia, **I:** South Asia, **J:** South East Asia, **K:** East Asia, **L:** Oceania.

Two regions in the world economy experienced increases in their intra-regional value added. This is the case of South East Asia that moved from 71% to 73% during the years here considered, and Central Asia with 74% in 1990 and 82% in 2011. In the case of South East Asia, we are referring again to major low cost producers for the World economy located in that region. This is the case of Indonesia, Malaysia, Vietnam, Singapore, Thailand and Philippines. As can be observed in figure 3.1 and 3.2, the higher intra-regional value added in South East Asia occurred at the expense of lower interaction with East Asian and European suppliers. This result also suggests that some technological upgrading is taking place within South East Asia. This could be particularly the case of Singapore and Vietnam that are generally regarded as countries that have followed a successful pattern of industrialization. As for the case of Central Asia, in my view, the increasing intra-regional value added observed in such regional is simply indicating that the increasing fragmentation of production led to a higher interaction of suppliers within such region. Producers in Central Asia do not export as much as manufacturing goods as other regions in Asia do. So, those producers in Central Asia did not have many pressures in looking for more competitive suppliers in other regions of Asia or from the World economy.[9]

Finally, one central observation from figure 3.1 and 3.2 is the relative importance of European suppliers for the manufacturing production in most of the developing World. Despite the industrial emergence of several Asian economies, most of the manufacturing producers in the developing world show increasing interaction with European suppliers. From 1990 to 2011, in most of the cases, producers in North Africa and the Middle East, in Sub-Saharan Africa, in Central Asia, in South Asia, in South East Asia and even in South America, show a strong intra-regional network of suppliers located in the European Union. The intra-regional interaction of countries in the developing world was always significantly higher than the corresponding one for Europe both in 1990 and in 2011. But our point is that, for developing economies, the increase in their interaction with intra-regional suppliers was as high as their increase in the interaction with European suppliers. In my view, the main reason for this tendency is the fact that most of the advanced economies are located in Europe. So the combined value added contribution from several global manufacturing powers will necessarily be higher than the corresponding one for countries like Japan, Canada and the US.

In a nutshell, figure 3.1 describes a story of regional fragmentation in that despite increases on the extra-regional value added component, at least 70% of the value added embodied in a given's regions final output is still generated within that same region. Furthermore, figure 3.1 reveals that regions such as Central America (B), South East Asia (J), Central Asia (H) even increased their regional ties. This latter situation indicates that different regions of world economy also respond differently to the increasing fragmentation by not increasing their interaction with extra-regional supplier but by doing it so with their immediate neighbors.

[9] Yet another reason for the increase in the intra-regional value added contribution from Central Asia is the fact that by 1990 those countries still belonged to the Soviet Union. So, the corresponding data for 1990 might actually indicate the tendency for interactions within the Soviet Union.

3.5 Conclusion and Points for Discussion.

In recent years, manufacturing producers in advanced and developing economies have witnessed an increasing fragmentation of their production processes. This fragmentation has been possible due to significant decreases in transportation and communication costs which enable the organization of manufacturing across long distances. Therefore, a large amount of countries are now able to interact with each other in order to produce a given manufacturing good. This increasing interaction among countries in the production of manufacturing goods has been labeled as the emergence of global value chains, given that different countries can add value in the final production from a given economy.

Current research has extensively indicated that the main outcome behind the emergence of global value chains has been a decrease in the domestic value added from local producers in final output at the expense of an increase in the foreign value added. The analysis here goes one step further and analyzes this process in a global context. This means that we focus on how the emergence of global value chains (i.e. the increasing fragmentation of manufacturing) impacts on the domestic and foreign value added from the top manufacturing exporters per product category and the one from all regions of the world economy. We do this by slicing up the value chain in the production of final manufacturing goods. We identified the contribution of domestic and foreign suppliers by country of origin. Then, we simply aggregated the value added by country of origin into different geographical regions of the world economy.

Our research identified a general tendency for the regional component of manufacturing in the World economy to increase. When analyzing the interaction of domestic suppliers with suppliers located in the same region and with suppliers outside their region in 1990 and 2011, we realized that even before the increasing fragmentation of manufacturing, domestic producers were interacting to a substantial degree with suppliers located in the same region. In general, the increasing fragmentation of production only increased the already high regionalization of manufacturing. Thus, the starting point in the analysis of value chains should not only be how large the regional interaction of a given country is with their own neighbors. Instead, it should be how much this regional component has grown, also compared to the interaction with suppliers located in other regions of the world economy.

The top manufacturing exporters of the world economy produce for competitive end-markets. As a result of the increasing fragmentation of production these exporters faced significant competition in terms of price and quality. In order to face this competition, domestic producers at top manufacturing countries were pushed to increase their network of suppliers beyond those available in their own region. This situation led each top exporters to an increase in the intra-regional value added embodied in the final output as well as an increase of the extra-regional value added. Depending on the specific features of each manufacturing sector, the value added from an extra regional group of countries highly specialized in a given good could grow as much as the regional value added of a top exporter, and even become higher. This is the case of the production of textiles, electronics and other manufacturing goods for the top manufacturing exporters. Here, the increase in the value added contribution from East Asia was higher or grew as much as the corresponding for one for the network of suppliers located in the same region as the top exporter. This higher East Asian value added was observed in some of the top manufacturing exporters of the aforementioned goods and was possible because the high modularity, low transportation and communication cost observed in these industries.

We will now discuss the intra-regional and extra-regional trends for the top manufacturing exporters in the rest of manufacturing goods. Again, in most cases, the increase in the intra-regional value added was higher than any individual extra-regional increase. This situation was possible due to the specific features governing the organization of production networks for the rest of industries. Here, we are referring to factors such as high tariff and non-tariff barriers imposed in the agricultural production, high transportation costs and proximity to end markets required by the transport industry, high safety costs for the chemical industry and so forth.

The last issue is the analysis of the impact of fragmentation in all the regions of the world economy. According to our results, the regions of the world economy responded differently as a result of the increasing fragmentation of production. In 20 years from 1990 to 2011, most regions decreased their interaction with suppliers within their own region by reducing the intra-regional value added embodied in total regional final output in 5%. Nevertheless, regions in Asia reacted differently to this whole process. Led by the increasing specialization of major low cost producers in the production of textiles, South Asia witnessed the highest decrease in the intra-regional value added (more than 10% in 20 years). On the other hand, following the successful industrialization and technological upgrading of some of the domestic suppliers within that region, South East Asia witnessed a higher intra-regional value added. Finally, given the lack of competitive pressures for domestic producers within their own region and the possibility to organize their production across neighbors, Central Asia also increased its intra-regional value added.

Another important conclusion derived from analyzing the impact of fragmentation in the regions of the world economy is the relative importance of European suppliers for manufacturing in developing economies. Asian suppliers (especially those in South East Asia and East Asia) drastically increased their manufacturing capabilities and achieved some level of upgrading. Despite this higher importance of Asian suppliers, in my view, only the top manufacturing exporters in sectors such as electronics have higher incentives to progressively rely on the efficient production from the Asian network of suppliers. In most cases, the network of European suppliers is the second option for manufacturing producers in the developing world after their own regional network. This situation, however, reflects the large number of European advanced economies investing in manufacturing at the developing world when compared to low number of advanced economies in Asia or North America.

Our research indicates that the increasing fragmentation of production, as a global phenomenon, has had different impacts on countries and regions of the world economy. A large number of factors account for these different impacts. We can point to particular characteristics in the production of manufacturing good, the impact of trade barriers, the competitive pressures faced by domestic suppliers, the technical capabilities of suppliers within a country's region and so forth. Nonetheless, we should keep in mind that there still are more issues that should be taken into account in order to further understand fragmentation. Many of the top manufacturing exporters in the developing world achieved outstanding results due to the implementation of export processing zones (Mexico, Pakistan, Vietnam, China and so forth). Those countries export an important amount of manufacturing goods. However, this situation occurs at the expense of inducing producers in the export processing zone to be specialized on the low value added stages of manufacturing with limited interaction with domestic suppliers. Analyzing the evolution of those domestic suppliers in those top manufacturing exporters should be the main objective of future research.

Finally, it is worth here discussing how our research differs from that of Los et al. (2015). The results presented in this chapter seem to confirm the findings from Los et al. (2015) for a larger number of countries and considering a different dataset (i.e. a higher presence from the extra-regional valued added that is embodied in a country's final output). Nevertheless, while Los et al. (2015) stresses the importance of the growth rate of the extra-regional component with respect to the one observed for the intra-regional component, this chapter stresses the importance of changes in the participation of those two components in total final output. To further clarify this idea, let us refer to the value added decomposition results for Germany as presented in table (3.1). As can be observed, the value added contribution from Europe in Germany's final output changed from 14% to 20% from 1990 to 2011, respectively. For the case of Asia, its value added contribution in Germany's output switched from 3% to 7% during the same period of time. In the view of Los et al. (2015), manufacturing production in Germany has become more globally oriented since the presence of extra-regional value added from Asian producers has considerably increased (a growth rate of 130%). The same conclusion would hold if we were to jointly consider all of the extra-regional components observed in Germany's final output. While we acknowledge the importance of the growth rate of the extra-regional component with respect to that of the intra-regional one (130% vs 43%, respectively), in my view, the predominant type of organization in German manufacturing is still regional. Even if the intra-regional component has not grown at the same considerable growth rate as the extra-regional component, this first component has clearly maintained its dominance as a share of final output: 20% versus 12% (total extra-regional contribution) in 2011. Higher extra-regional interaction of manufacturing firms in Germany did not necessarily come at the expense lower intra-regional interaction. Both components increased as a result of lower interaction with domestic suppliers. Any further increase on the extra-regional component will necessarily imply an increase on the intra-regional one. More importantly, in spite of different growth rates between the extra and intra-regional component, manufacturing production will mostly remain regional given that a limited number of sectors within total manufacturing (textiles, electronics and other manufacturing) have an incentive to seek for suppliers beyond those available locally and in their own respective region.

Appendix A3.1.

Value Chain Decomposition from Top Manufacturing Exporters.

A3.1.1 Total Final Manufacturing production
Share of value added embodied in the Reporter's final manufacturing output.

	Germany		USA		Japan		Italy		China		Mexico	
	1990	2011	1990	2011	1990	2011	1990	2011	1990	2011	1990	2011
Total Value Added	100	100	100	100	100	100	100	100	100	100	100	100
EUROPE	94.0	88.5	4.1	5.6	2.7	3.5	94.6	88.8	2.8	6.1	4.0	6.6
France	2.0	2.6	0.5	0.6	0.3	0.4	2.6	3.2	0.3	0.7	0.5	0.8
Netherlands	1.4	1.7	0.2	0.3	0.1	0.2	1.1	1.4	0.1	0.3	0.2	0.3
Germany	80.2	68.3	1.0	1.3	0.6	0.7	4.3	5.5	0.6	1.6	1.0	1.5
Italy	1.9	2.3	0.4	0.5	0.2	0.3	79.2	67.4	0.2	0.5	0.5	0.8
Spain	0.6	1.1	0.1	0.2	0.1	0.1	1.0	1.5	0.1	0.2	0.3	0.7
Belgium	0.9	1.2	0.1	0.2	0.1	0.1	0.9	1.1	0.1	0.2	0.1	0.2
Sweden	0.8	0.7	0.2	0.2	0.1	0.1	0.7	0.5	0.2	0.2	0.2	0.2
Russia	0.6	1.2	0.2	0.4	0.5	0.6	0.5	1.0	0.7	0.7	0.2	0.4
UK	1.2	1.7	0.6	0.6	0.2	0.3	1.3	1.6	0.2	0.6	0.3	0.5
Switzerland	0.8	1.7	0.1	0.3	0.1	0.2	0.5	1.0	0.1	0.3	0.2	0.4
Rest of Europe	3.6	6.2	0.5	0.9	0.4	0.5	2.7	4.5	0.3	0.9	0.4	0.9
NAFTA	2.2	2.7	91.6	84.9	3.2	3.1	1.7	2.2	2.1	2.3	93.1	84.4
USA	2.0	2.3	89.0	79.9	2.7	2.4	1.5	1.9	1.9	1.8	11.7	11.8
Canada	0.2	0.3	2.2	3.6	0.4	0.6	0.1	0.2	0.1	0.4	0.6	1.2
Mexico	0.1	0.1	0.5	1.4	0.1	0.1	0.0	0.1	0.1	0.1	80.8	71.3
Central, South America and the Caribbean	0.4	0.8	1.0	2.4	0.3	0.5	0.4	0.9	0.3	0.7	0.7	2.2
Brazil	0.2	0.4	0.2	0.4	0.1	0.2	0.2	0.4	0.2	0.3	0.3	0.8
Argentina	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.2
Rest of countries	0.1	0.3	0.8	1.9	0.1	0.3	0.2	0.4	0.1	0.3	0.3	1.2
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AFRICA	0.5	0.9	0.3	0.7	0.2	0.3	0.9	1.4	0.1	0.5	0.1	0.4
ASIA	2.8	6.7	2.8	6.1	93.0	91.2	2.3	6.4	94.3	89.6	2.0	6.2
China	0.4	2.6	0.3	2.0	0.6	2.8	0.4	2.4	90.8	81.3	0.2	2.5
Hong Kong	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South Korea	0.1	0.3	0.2	0.5	0.4	0.8	0.1	0.3	0.5	1.9	0.2	0.6
Indonesia	0.1	0.3	0.1	0.2	0.3	0.9	0.1	0.3	0.1	0.6	0.0	0.3
India	0.1	0.5	0.1	0.3	0.1	0.3	0.1	0.6	0.1	0.4	0.1	0.5
Singapore	0.0	0.1	0.0	0.1	0.1	0.2	0.0	0.1	0.0	0.3	0.0	0.1
Japan	1.3	1.3	1.7	1.6	90.6	83.8	0.7	0.9	2.2	3.2	1.2	1.1
Thailand	0.1	0.2	0.1	0.2	0.1	0.3	0.1	0.2	0.1	0.3	0.1	0.2
Viet Nam	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0
Bangladesh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Turkey	0.3	0.4	0.0	0.1	0.0	0.0	0.3	0.4	0.0	0.0	0.0	0.1
Rest of countries	0.3	1.1	0.4	1.1	0.8	2.1	0.4	1.2	0.4	1.6	0.2	0.8
OCEANIA	0.1	0.3	0.1	0.3	0.6	1.3	0.1	0.3	0.3	0.8	0.1	0.2
Australia	0.1	0.2	0.1	0.3	0.5	1.2	0.1	0.2	0.3	0.7	0.1	0.2
Rest of countries	0.0	0.1	0.0	0.1	0.1	0.2	0.0	0.1	0.0	0.1	0.0	0.0

Source: Author's calculation based on equation (3.1) to (3.4) and using EORA data set

A3.1.2 Food & Beverages
Share of value added embodied in the Reporter's final manufacturing output.

	France		Netherlands		Germany		USA		China		Italy	
	1990	2011	1990	2011	1990	2011	1990	2011	1990	2011	1990	2011
Total Value Added	100	100	100	100	100	100	100	100	100	100	100	100
EUROPE	94.9	92.4	90.7	82.8	94.6	89.0	3.0	4.2	1.7	2.9	96.3	92.0
France	82.3	77.9	2.7	3.3	1.7	2.4	0.3	0.4	0.1	0.3	2.2	3.0
Netherlands	1.2	1.3	70.0	55.9	1.9	2.9	0.4	0.5	0.1	0.2	1.1	1.5
Germany	3.0	3.3	6.3	7.8	83.1	70.9	0.6	0.9	0.3	0.7	2.7	3.7
Italy	1.6	1.6	1.4	1.8	1.4	1.9	0.3	0.4	0.1	0.2	85.2	75.4
Spain	1.2	1.6	1.4	1.8	0.8	1.3	0.1	0.2	0.1	0.1	1.0	1.6
Belgium	1.3	1.5	3.0	3.8	0.8	1.2	0.1	0.2	0.1	0.1	0.6	0.9
Sweden	0.5	0.3	0.7	0.5	0.5	0.4	0.1	0.1	0.1	0.1	0.4	0.3
Russia	0.5	0.6	0.5	0.7	0.4	0.8	0.1	0.2	0.6	0.4	0.3	0.6
UK	1.1	1.3	1.7	2.2	0.8	1.2	0.4	0.4	0.1	0.2	0.8	1.1
Switzerland	0.3	0.5	0.3	0.5	0.4	0.8	0.1	0.2	0.1	0.1	0.2	0.5
Rest of Europe	1.8	2.4	2.8	4.4	2.8	5.3	0.4	0.7	0.2	0.4	1.9	3.4
NAFTA	1.8	1.9	3.0	3.7	1.8	2.4	94.3	89.7	1.6	1.4	1.1	1.6
USA	1.6	1.5	2.5	2.9	1.4	1.8	91.3	84.7	1.5	1.1	0.9	1.3
Canada	0.2	0.2	0.4	0.6	0.3	0.5	2.5	3.9	0.1	0.3	0.1	0.2
Mexico	0.1	0.1	0.1	0.2	0.1	0.1	0.5	1.1	0.1	0.0	0.0	0.1
Central, South America and the Caribbean	0.4	0.8	1.5	3.0	0.7	1.6	0.9	1.9	0.2	0.4	0.5	1.2
Brazil	0.2	0.3	0.6	1.2	0.3	0.7	0.2	0.4	0.1	0.1	0.2	0.5
Argentina	0.1	0.1	0.3	0.6	0.1	0.3	0.1	0.2	0.0	0.1	0.1	0.3
Rest of countries	0.2	0.3	0.6	1.2	0.3	0.6	0.7	1.4	0.1	0.2	0.2	0.4
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AFRICA	0.9	1.3	1.1	2.1	0.6	1.3	0.2	0.5	0.1	0.3	0.7	1.2
ASIA	1.8	3.4	3.4	7.8	2.2	5.2	1.4	3.3	96.2	94.6	1.3	3.7
China	0.3	1.1	0.5	2.4	0.4	1.5	0.2	1.1	94.4	91.1	0.2	1.1
Hong Kong	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South Korea	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.2	0.6	0.1	0.1
Indonesia	0.1	0.2	0.3	0.7	0.1	0.3	0.1	0.2	0.1	0.4	0.1	0.2
India	0.1	0.4	0.2	0.9	0.1	0.6	0.1	0.3	0.0	0.2	0.1	0.4
Singapore	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1
Japan	0.6	0.5	0.8	0.8	0.5	0.5	0.6	0.6	1.0	1.1	0.3	0.4
Thailand	0.1	0.1	0.2	0.5	0.1	0.2	0.1	0.1	0.1	0.2	0.1	0.1
Viet Nam	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bangladesh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Turkey	0.2	0.2	0.6	0.6	0.5	0.7	0.1	0.1	0.0	0.0	0.3	0.4
Rest of countries	0.4	0.7	0.6	1.4	0.3	0.9	0.3	0.7	0.3	0.8	0.3	0.8
OCEANIA	0.1	0.2	0.3	0.6	0.2	0.5	0.2	0.4	0.2	0.4	0.1	0.4
Australia	0.1	0.1	0.2	0.3	0.1	0.3	0.1	0.3	0.2	0.4	0.1	0.2
Rest of countries	0.1	0.1	0.1	0.3	0.1	0.3	0.1	0.1	0.0	0.1	0.1	0.1

Source: as described in table (A3.1.1)

A3.1.3 Textiles and Wearing Apparel
Share of value added embodied in the Reporter's final manufacturing output.

	China		Italy		India		Japan		Turkey		Indonesia	
	1990	2011	1990	2011	1990	2011	1990	2011	1990	2011	1990	2011
Total Value Added	100	100	100	100	100	100	100	100	100	100	100	100
EUROPE	2.8	4.5	93.9	86.5	2.7	5.4	3.7	4.9	10.9	21.4	6.3	4.4
France	0.2	0.5	2.6	3.1	0.3	0.5	0.4	0.6	1.1	2.1	0.6	0.5
Netherlands	0.1	0.2	1.0	1.3	0.2	0.3	0.1	0.2	0.7	1.2	0.6	0.4
Germany	0.5	1.0	3.5	4.0	0.7	1.1	0.5	0.7	2.8	4.3	1.4	1.0
Italy	0.3	0.7	79.5	66.9	0.3	0.6	0.8	1.3	2.0	3.6	0.5	0.3
Spain	0.1	0.2	1.2	1.7	0.1	0.2	0.1	0.2	0.4	1.2	0.2	0.2
Belgium	0.1	0.2	0.8	1.1	0.2	0.3	0.1	0.2	0.5	1.0	0.4	0.3
Sweden	0.1	0.1	0.4	0.3	0.1	0.1	0.1	0.1	0.3	0.3	0.2	0.1
Russia	0.8	0.4	0.4	0.7	0.2	0.4	0.7	0.3	0.6	1.6	0.6	0.3
UK	0.2	0.4	1.1	1.4	0.3	0.6	0.2	0.4	0.7	1.5	0.6	0.5
Switzerland	0.1	0.2	0.4	0.8	0.2	0.4	0.1	0.2	0.3	0.8	0.2	0.2
Rest of Europe	0.3	0.6	3.1	5.1	0.3	0.7	0.4	0.6	1.4	3.8	0.8	0.7
NAFTA	2.4	1.6	1.5	1.9	0.8	1.6	3.0	2.2	1.1	1.9	3.7	2.2
USA	2.2	1.3	1.3	1.6	0.8	1.4	2.6	1.8	1.0	1.6	3.4	1.9
Canada	0.1	0.3	0.1	0.2	0.1	0.2	0.3	0.3	0.1	0.2	0.2	0.2
Mexico	0.1	0.1	0.0	0.1	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.0
Central, South America and the Caribbean	0.3	0.4	0.4	0.9	0.1	0.3	0.3	0.5	0.2	0.6	0.4	0.4
Brazil	0.2	0.2	0.2	0.4	0.0	0.1	0.2	0.2	0.1	0.3	0.2	0.2
Argentina	0.0	0.1	0.1	0.2	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0
Rest of countries	0.1	0.2	0.2	0.4	0.0	0.1	0.1	0.2	0.1	0.2	0.1	0.2
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AFRICA	0.2	0.4	0.8	1.6	0.1	0.5	0.2	0.3	0.4	1.2	0.4	0.3
ASIA	94.1	92.4	3.1	8.8	96.0	91.7	92.2	91.3	87.4	74.8	87.5	91.2
China	89.7	85.5	0.6	3.7	0.1	2.0	0.9	4.9	0.3	3.1	1.3	3.9
Hong Kong	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South Korea	1.0	1.6	0.2	0.3	0.2	0.4	0.7	0.7	0.2	0.4	2.2	1.1
Indonesia	0.2	0.6	0.1	0.4	0.1	0.5	0.4	1.1	0.0	0.3	77.4	80.1
India	0.1	0.5	0.4	1.2	94.4	85.9	0.2	0.9	0.2	1.3	0.3	0.7
Singapore	0.0	0.2	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.1	0.5	1.0
Japan	2.4	2.0	0.6	0.8	0.7	0.7	88.8	81.5	0.4	0.6	3.6	2.0
Thailand	0.1	0.3	0.1	0.2	0.1	0.2	0.2	0.4	0.0	0.1	0.5	0.5
Viet Nam	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Bangladesh	0.0	0.0	0.1	0.2	0.1	0.2	0.0	0.1	0.0	0.1	0.0	0.0
Turkey	0.0	0.0	0.5	0.6	0.0	0.1	0.1	0.1	85.6	66.8	0.4	0.2
Rest of countries	0.5	1.6	0.5	1.3	0.4	1.5	0.8	1.5	0.5	2.0	1.3	1.8
OCEANIA	0.4	0.7	0.2	0.3	0.2	0.5	0.6	0.9	0.1	0.2	1.6	1.5
Australia	0.3	0.5	0.1	0.2	0.1	0.4	0.5	0.7	0.1	0.2	1.5	1.4
Rest of countries	0.0	0.2	0.0	0.1	0.0	0.1	0.1	0.2	0.0	0.1	0.1	0.1

Source: as described in table (A3.1.1)

A3.1.4 Wood and Paper

Share of value added embodied in the Reporter's final manufacturing output.

	China		Germany		UK		USA		Italy		France	
	1990	**2011**	**1990**	**2011**	**1990**	**2011**	**1990**	**2011**	**1990**	**2011**	**1990**	**2011**
Total Value Added	100	100	100	100	100	100	100	100	100	100	100	100
EUROPE	2.4	6.0	96.7	93.5	94.2	89.9	3.4	4.7	95.8	91.0	95.4	93.4
France	0.2	0.6	1.4	2.0	2.0	2.4	0.4	0.5	2.4	3.1	80.0	75.9
Netherlands	0.1	0.2	1.0	1.5	1.4	1.8	0.2	0.2	0.8	1.2	1.0	1.1
Germany	0.5	1.5	85.1	75.8	3.9	4.8	0.9	1.2	4.0	5.3	4.0	4.4
Italy	0.2	0.4	1.1	1.5	1.1	1.3	0.3	0.4	80.7	69.7	1.9	1.9
Spain	0.1	0.2	0.3	0.6	0.4	0.9	0.1	0.2	0.8	1.3	1.2	1.5
Belgium	0.1	0.2	0.7	1.0	1.0	1.3	0.1	0.1	0.8	1.0	1.3	1.5
Sweden	0.1	0.2	1.6	1.4	1.6	1.3	0.3	0.2	1.5	1.2	1.4	1.0
Russia	0.5	1.0	0.3	0.7	0.3	0.6	0.1	0.2	0.3	0.7	0.4	0.6
UK	0.2	0.5	0.9	1.3	79.4	70.2	0.4	0.4	1.1	1.4	1.3	1.5
Switzerland	0.1	0.3	0.7	1.5	0.3	0.5	0.1	0.2	0.5	1.0	0.4	0.8
Rest of Europe	0.3	0.8	3.4	6.1	2.9	4.6	0.6	0.9	2.9	5.1	2.4	3.2
NAFTA	1.6	2.5	1.5	2.1	3.1	3.5	94.0	89.3	1.5	2.0	2.0	1.9
USA	1.4	1.8	1.3	1.6	2.7	2.8	90.8	83.9	1.3	1.6	1.7	1.6
Canada	0.2	0.6	0.2	0.4	0.4	0.6	3.0	4.7	0.2	0.3	0.2	0.3
Mexico	0.0	0.1	0.0	0.1	0.0	0.1	0.3	0.7	0.0	0.1	0.0	0.1
Central, South America and the Caribbean	0.2	0.5	0.2	0.5	0.3	0.7	0.8	1.9	0.4	0.9	0.3	0.6
Brazil	0.1	0.2	0.1	0.3	0.2	0.4	0.3	0.7	0.2	0.5	0.2	0.4
Argentina	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0
Rest of countries	0.1	0.2	0.1	0.2	0.1	0.2	0.5	1.1	0.1	0.3	0.1	0.2
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AFRICA	0.1	0.5	0.3	0.5	0.4	0.7	0.2	0.5	0.7	1.2	0.7	0.9
ASIA	95.4	89.8	1.2	3.3	1.9	5.0	1.4	3.5	1.6	4.7	1.6	3.1
China	92.9	82.7	0.2	1.2	0.3	1.7	0.2	1.2	0.3	1.8	0.3	1.1
Hong Kong	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South Korea	0.4	1.4	0.1	0.1	0.1	0.3	0.1	0.3	0.1	0.2	0.1	0.1
Indonesia	0.2	1.1	0.1	0.2	0.1	0.4	0.1	0.2	0.1	0.4	0.1	0.2
India	0.0	0.3	0.0	0.2	0.1	0.4	0.0	0.2	0.1	0.3	0.1	0.2
Singapore	0.0	0.2	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.1	0.0	0.1
Japan	1.4	2.1	0.5	0.5	0.8	0.8	0.7	0.7	0.5	0.6	0.6	0.5
Thailand	0.1	0.5	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.2	0.1	0.1
Viet Nam	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bangladesh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Turkey	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.2	0.1	0.1
Rest of countries	0.3	1.5	0.2	0.6	0.3	0.9	0.3	0.7	0.3	0.9	0.3	0.6
OCEANIA	0.2	0.7	0.0	0.1	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.1
Australia	0.2	0.5	0.0	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Rest of countries	0.0	0.2	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0

Source: as described in table (A3.1.1)

A3.1.5 Metal Products
Share of value added embodied in the Reporter's final manufacturing output.

	China		Germany		Italy		USA		Japan		France	
	1990	**2011**	**1990**	**2011**	**1990**	**2011**	**1990**	**2011**	**1990**	**2011**	**1990**	**2011**
Total Value Added	100	100	100	100	100	100	100	100	100	100	100	100
EUROPE	2.4	5.5	94.7	89.6	95.6	90.9	4.6	6.5	2.9	4.0	94.2	91.3
France	0.2	0.5	2.0	2.4	2.5	3.1	0.5	0.6	0.3	0.4	75.7	71.0
Netherlands	0.1	0.2	1.1	1.3	0.9	1.1	0.2	0.2	0.1	0.1	1.1	1.2
Germany	0.6	1.4	81.0	70.4	4.4	5.6	1.2	1.5	0.5	0.7	5.2	5.4
Italy	0.2	0.4	1.5	1.8	80.1	69.5	0.4	0.5	0.1	0.2	2.7	2.6
Spain	0.1	0.2	0.4	0.7	0.8	1.4	0.1	0.2	0.1	0.1	1.1	1.6
Belgium	0.1	0.2	1.1	1.3	0.8	1.1	0.2	0.3	0.1	0.1	1.9	2.0
Sweden	0.1	0.2	0.9	0.7	0.9	0.7	0.3	0.3	0.2	0.2	1.1	0.7
Russia	0.4	0.8	1.0	2.1	0.6	1.3	0.5	1.2	0.8	1.3	0.7	1.0
UK	0.2	0.5	1.2	1.6	1.3	1.5	0.6	0.6	0.2	0.3	1.7	1.8
Switzerland	0.1	0.3	0.8	1.4	0.5	1.0	0.1	0.2	0.1	0.1	0.6	0.9
Rest of Europe	0.3	0.7	3.8	5.9	2.7	4.5	0.6	1.0	0.4	0.6	2.5	3.2
NAFTA	1.3	2.0	2.0	2.7	1.4	2.0	91.9	85.5	2.4	2.8	2.2	2.2
USA	1.2	1.6	1.8	2.2	1.3	1.6	89.9	81.6	1.9	1.9	1.9	1.8
Canada	0.1	0.4	0.2	0.4	0.1	0.3	1.6	3.0	0.4	0.7	0.2	0.3
Mexico	0.0	0.1	0.0	0.1	0.0	0.1	0.4	0.9	0.1	0.1	0.1	0.1
Central, South America and the Caribbean	0.5	1.8	0.5	1.2	0.4	1.0	0.8	1.8	0.7	1.7	0.5	0.8
Brazil	0.4	1.2	0.3	0.6	0.2	0.4	0.3	0.6	0.3	0.5	0.3	0.4
Argentina	0.0	0.1	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.0	0.0
Rest of countries	0.1	0.5	0.3	0.6	0.2	0.5	0.5	1.1	0.4	1.1	0.2	0.3
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AFRICA	0.2	0.8	0.8	1.4	0.7	1.3	0.3	0.6	0.5	1.1	0.9	1.3
ASIA	94.9	88.2	1.8	4.7	1.7	4.6	2.2	5.1	92.3	87.7	2.0	3.9
China	92.0	80.5	0.3	1.9	0.2	1.7	0.2	1.5	0.8	3.5	0.3	1.6
Hong Kong	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South Korea	0.4	1.9	0.1	0.2	0.1	0.3	0.2	0.7	0.4	1.2	0.1	0.2
Indonesia	0.1	0.5	0.1	0.2	0.1	0.2	0.0	0.2	0.5	1.0	0.1	0.1
India	0.2	0.8	0.1	0.3	0.1	0.3	0.1	0.4	0.1	0.4	0.1	0.3
Singapore	0.0	0.2	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1
Japan	1.8	2.6	0.8	0.8	0.6	0.7	1.3	1.3	89.6	79.4	0.9	0.7
Thailand	0.1	0.2	0.0	0.1	0.0	0.1	0.0	0.1	0.1	0.2	0.1	0.1
Viet Nam	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bangladesh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Turkey	0.0	0.0	0.2	0.2	0.3	0.3	0.1	0.1	0.0	0.0	0.1	0.1
Rest of countries	0.3	1.3	0.2	1.0	0.3	0.9	0.3	0.8	0.7	1.9	0.3	0.7
OCEANIA	0.6	1.8	0.2	0.4	0.1	0.4	0.2	0.5	1.1	2.7	0.2	0.4
Australia	0.6	1.7	0.2	0.4	0.1	0.3	0.2	0.4	0.9	2.3	0.2	0.4
Rest of countries	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.2	0.3	0.1	0.1

Source: as described in table (A3.1.1)

A3.1.6 Petroleum, Chemical and Non-Metallic Mineral Products
Share of value added embodied in the Reporter's final manufacturing output.

	Germany		**USA**		**France**		**China**		**Italy**		**UK**	
	1990	**2011**	**1990**	**2011**	**1990**	**2011**	**1990**	**2011**	**1990**	**2011**	**1990**	**2011**
Total Value Added	100	100	100	100	100	100	100	100	100	100	100	100
EUROPE	93.6	87.9	3.7	4.7	90.2	85.6	2.7	5.7	92.7	85.5	93.6	88.8
France	2.3	2.9	0.4	0.5	67.8	60.7	0.3	0.6	3.1	3.7	1.9	2.2
Netherlands	2.0	2.4	0.2	0.3	1.8	1.7	0.1	0.3	1.5	2.2	1.4	1.7
Germany	77.3	64.3	0.9	1.0	5.1	5.1	0.6	1.3	5.2	6.2	3.3	4.1
Italy	1.5	1.6	0.3	0.4	2.1	1.9	0.2	0.5	73.7	59.2	1.0	1.2
Spain	0.5	0.8	0.1	0.2	1.1	1.4	0.1	0.2	1.0	1.6	0.4	0.9
Belgium	1.5	1.8	0.2	0.2	1.8	2.0	0.1	0.2	1.2	1.5	1.0	1.3
Sweden	0.7	0.5	0.2	0.1	0.7	0.4	0.1	0.2	0.7	0.5	0.7	0.6
Russia	1.4	3.3	0.1	0.3	2.0	3.0	0.7	0.9	1.1	2.1	0.5	0.9
UK	1.9	2.7	0.6	0.6	2.2	2.4	0.2	0.5	1.7	2.2	79.8	70.3
Switzerland	0.7	1.4	0.1	0.3	0.6	1.0	0.1	0.3	0.6	1.2	0.3	0.6
Rest of Europe	3.8	6.2	0.6	0.9	4.8	5.8	0.3	0.7	2.8	5.1	3.2	5.1
NAFTA	2.3	3.0	89.9	81.4	2.5	2.6	1.9	2.2	2.0	2.8	3.1	3.7
USA	2.1	2.5	85.5	74.2	2.3	2.2	1.7	1.8	1.7	2.3	2.8	3.2
Canada	0.2	0.3	3.9	6.0	0.2	0.3	0.1	0.4	0.2	0.3	0.2	0.4
Mexico	0.1	0.2	0.6	1.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2
Central, South America and the Caribbean	0.4	0.9	3.0	6.8	0.4	0.7	0.2	0.5	0.4	1.0	0.3	0.6
Brazil	0.2	0.4	0.1	0.3	0.2	0.3	0.1	0.3	0.2	0.4	0.1	0.3
Argentina	0.0	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.1	0.1	0.0	0.1
Rest of countries	0.2	0.5	2.8	6.4	0.2	0.3	0.1	0.2	0.2	0.4	0.1	0.3
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AFRICA	1.0	1.8	0.9	2.0	3.8	5.3	0.2	1.0	2.2	3.0	0.6	1.1
ASIA	2.5	6.2	2.4	5.0	2.9	5.7	94.6	89.9	2.6	7.5	2.2	5.5
China	0.5	2.2	0.2	1.2	0.4	1.6	91.6	82.8	0.4	2.2	0.3	1.9
Hong Kong	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South Korea	0.1	0.2	0.1	0.2	0.1	0.2	0.4	1.2	0.1	0.3	0.1	0.3
Indonesia	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.7	0.1	0.3	0.1	0.2
India	0.1	0.5	0.1	0.3	0.1	0.4	0.0	0.4	0.1	0.6	0.1	0.5
Singapore	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.2
Japan	1.0	0.9	0.9	0.8	1.0	0.8	1.7	2.3	0.8	0.9	0.9	0.9
Thailand	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.3	0.1	0.1	0.1	0.1
Viet Nam	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0
Bangladesh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Turkey	0.2	0.2	0.0	0.1	0.1	0.1	0.0	0.0	0.2	0.3	0.1	0.2
Rest of countries	0.5	1.7	1.0	2.0	1.0	2.2	0.5	1.8	0.8	2.6	0.4	1.2
OCEANIA	0.1	0.2	0.1	0.2	0.1	0.2	0.2	0.6	0.1	0.3	0.2	0.3
Australia	0.1	0.2	0.1	0.2	0.1	0.1	0.2	0.5	0.1	0.2	0.1	0.2
Rest of countries	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1

Source: as described in table (A3.1.1)

A3.1.7 Electrical and Machinery
Share of value added embodied in the Reporter's final manufacturing output.

	China		Germany		USA		Japan		UK		France	
	1990	**2011**	**1990**	**2011**	**1990**	**2011**	**1990**	**2011**	**1990**	**2011**	**1990**	**2011**
Total Value Added	100	100	100	100	100	100	100	100	100	100	100	100
EUROPE	3.9	8.4	94.0	89.0	3.9	5.7	2.8	3.6	89.2	84.1	92.3	89.1
France	0.4	1.0	1.7	2.1	0.5	0.6	0.3	0.4	2.2	2.5	74.7	70.2
Netherlands	0.1	0.3	1.0	1.2	0.2	0.2	0.1	0.1	1.3	1.6	1.1	1.1
Germany	1.0	2.2	82.7	72.7	1.0	1.4	0.6	0.8	4.1	4.9	5.0	5.2
Italy	0.3	0.7	1.4	1.7	0.4	0.5	0.2	0.2	1.4	1.6	2.7	2.4
Spain	0.1	0.3	0.4	0.7	0.1	0.2	0.1	0.1	0.4	0.8	1.0	1.4
Belgium	0.1	0.3	0.7	0.9	0.1	0.2	0.1	0.1	0.9	1.1	1.4	1.4
Sweden	0.2	0.3	0.6	0.5	0.2	0.2	0.2	0.1	0.7	0.6	0.7	0.5
Russia	0.6	0.8	0.4	0.9	0.2	0.5	0.5	0.5	0.4	0.7	0.5	0.7
UK	0.3	0.8	1.2	1.5	0.6	0.7	0.3	0.4	74.9	65.5	1.9	2.0
Switzerland	0.1	0.5	0.9	1.9	0.1	0.3	0.1	0.2	0.4	0.8	0.7	1.1
Rest of Europe	0.5	1.2	3.1	5.1	0.5	0.9	0.3	0.5	2.4	4.0	2.4	3.1
NAFTA	2.5	2.9	2.3	2.7	92.2	85.2	3.2	2.9	5.2	4.8	3.1	2.7
USA	2.3	2.4	2.2	2.3	90.6	81.8	2.9	2.4	4.8	4.0	2.8	2.3
Canada	0.1	0.4	0.1	0.3	1.2	2.2	0.2	0.3	0.3	0.6	0.2	0.3
Mexico	0.1	0.1	0.0	0.1	0.4	1.2	0.1	0.1	0.1	0.2	0.1	0.1
Central, South America and the Caribbean	0.3	0.8	0.2	0.5	0.5	1.2	0.2	0.4	0.3	0.6	0.3	0.5
Brazil	0.2	0.5	0.1	0.3	0.1	0.3	0.1	0.2	0.1	0.3	0.2	0.3
Argentina	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Rest of countries	0.1	0.3	0.1	0.2	0.4	0.8	0.1	0.3	0.1	0.3	0.1	0.2
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AFRICA	0.2	0.6	0.3	0.5	0.2	0.4	0.2	0.3	0.4	0.8	0.6	0.9
ASIA	92.6	86.2	3.0	7.0	3.1	7.1	93.2	92.0	4.7	9.3	3.6	6.6
China	87.8	74.4	0.4	2.9	0.3	2.4	0.5	3.0	0.4	3.3	0.4	2.8
Hong Kong	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South Korea	0.6	2.8	0.1	0.4	0.2	0.6	0.4	1.0	0.3	0.6	0.2	0.4
Indonesia	0.1	0.6	0.0	0.2	0.0	0.2	0.3	0.6	0.1	0.3	0.1	0.2
India	0.1	0.4	0.1	0.3	0.1	0.3	0.0	0.2	0.1	0.4	0.1	0.3
Singapore	0.1	0.4	0.0	0.2	0.0	0.2	0.1	0.2	0.1	0.3	0.1	0.2
Japan	3.4	5.0	1.8	1.5	2.0	2.0	91.0	84.7	2.9	2.3	2.0	1.3
Thailand	0.1	0.4	0.1	0.2	0.1	0.2	0.1	0.3	0.1	0.3	0.1	0.2
Viet Nam	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bangladesh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Turkey	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
Rest of countries	0.4	2.1	0.3	1.1	0.3	1.2	0.7	1.9	0.5	1.7	0.5	1.1
OCEANIA	0.4	1.0	0.1	0.2	0.1	0.3	0.4	0.8	0.2	0.5	0.1	0.2
Australia	0.4	1.0	0.1	0.2	0.1	0.3	0.4	0.7	0.2	0.4	0.1	0.2
Rest of countries	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.0

Source: as described in table (A3.1.1)

A3.1.8 Transport Equipment
Share of value added embodied in the Reporter's final manufacturing output.

	Germany		Japan		Mexico		Canada		South Korea		India	
	1990	**2011**	**1990**	**2011**	**1990**	**2011**	**1990**	**2011**	**1990**	**2011**	**1990**	**2011**
Total Value Added	100	100	100	100	100	100	100	100	100	100	100	100
EUROPE	93.3	88.1	2.6	3.3	6.2	9.2	6.3	7.9	8.4	9.8	4.3	8.6
France	2.9	3.3	0.3	0.4	0.9	1.1	0.8	0.9	0.9	1.0	0.4	0.7
Netherlands	1.4	1.7	0.1	0.1	0.2	0.3	0.2	0.3	0.3	0.4	0.2	0.4
Germany	75.1	63.4	0.6	0.7	1.8	2.3	1.6	1.9	2.5	2.8	1.0	1.9
Italy	2.9	3.1	0.2	0.2	0.8	1.1	0.8	0.9	0.7	0.8	0.4	0.7
Spain	1.0	1.7	0.1	0.1	0.4	0.9	0.2	0.3	0.2	0.3	0.1	0.3
Belgium	1.1	1.3	0.1	0.1	0.2	0.3	0.2	0.2	0.3	0.3	0.2	0.4
Sweden	1.3	1.0	0.2	0.1	0.3	0.3	0.4	0.3	0.7	0.5	0.2	0.3
Russia	0.6	1.1	0.5	0.5	0.2	0.5	0.2	0.4	0.8	0.7	0.4	1.2
UK	1.6	2.0	0.3	0.3	0.5	0.7	1.0	1.1	0.7	0.9	0.6	1.0
Switzerland	1.0	2.0	0.1	0.1	0.3	0.6	0.2	0.4	0.3	0.5	0.2	0.6
Rest of Europe	4.4	7.5	0.3	0.4	0.6	1.1	0.7	1.2	0.9	1.4	0.5	1.1
NAFTA	2.7	3.1	2.9	2.6	89.0	78.6	86.7	81.4	5.7	4.9	1.2	2.3
USA	2.4	2.7	2.5	2.2	18.5	15.1	27.1	25.4	5.2	4.2	1.1	2.0
Canada	0.2	0.3	0.3	0.4	0.8	1.7	58.9	53.6	0.3	0.5	0.1	0.3
Mexico	0.1	0.2	0.1	0.1	69.7	61.8	0.7	2.4	0.1	0.1	0.0	0.1
Central, South America and the Caribbean	0.3	0.8	0.3	0.5	1.0	2.7	0.5	1.4	0.5	0.7	0.2	0.6
Brazil	0.2	0.4	0.1	0.2	0.5	1.4	0.3	0.8	0.2	0.2	0.1	0.2
Argentina	0.0	0.1	0.0	0.0	0.1	0.2	0.0	0.1	0.0	0.0	0.0	0.1
Rest of countries	0.1	0.3	0.1	0.3	0.4	1.1	0.2	0.6	0.2	0.4	0.1	0.3
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AFRICA	0.4	0.8	0.2	0.3	0.2	0.5	0.2	0.4	0.3	0.6	0.2	0.7
ASIA	3.1	7.0	93.6	92.3	3.5	8.7	6.1	8.6	84.5	83.0	93.9	86.9
China	0.4	2.6	0.5	2.5	0.3	3.5	0.3	2.8	1.0	5.8	0.2	2.3
Hong Kong	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South Korea	0.2	0.4	0.3	0.8	0.3	0.9	0.3	0.8	71.9	64.1	0.3	1.1
Indonesia	0.1	0.2	0.3	0.8	0.1	0.3	0.1	0.2	0.7	1.8	0.1	0.4
India	0.1	0.4	0.0	0.2	0.1	0.5	0.1	0.3	0.1	0.5	91.5	79.2
Singapore	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.1	0.3	0.1	0.3
Japan	1.8	1.7	91.5	85.7	2.3	2.0	4.9	3.3	8.6	6.1	1.2	1.3
Thailand	0.1	0.2	0.1	0.3	0.1	0.3	0.1	0.2	0.1	0.3	0.0	0.2
Viet Nam	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bangladesh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Turkey	0.2	0.4	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1
Rest of countries	0.3	1.0	0.7	1.8	0.3	1.0	0.3	0.8	1.9	4.0	0.5	1.9
OCEANIA	0.1	0.2	0.5	1.0	0.1	0.3	0.2	0.4	0.7	1.1	0.3	0.9
Australia	0.1	0.2	0.4	0.9	0.1	0.2	0.1	0.3	0.6	1.0	0.3	0.8
Rest of countries	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0

Source: as described in table (A3.1.1)

A3.1.9 Other Manufacturing
Share of value added embodied in the Reporter's final manufacturing output.

	China		Italy		Germany		USA		Canada		Thailand	
	1990	**2011**	**1990**	**2011**	**1990**	**2011**	**1990**	**2011**	**1990**	**2011**	**1990**	**2011**
Total Value Added	100	100	100	100	100	100	100	100	100	100	100	100
EUROPE	3.0	5.6	94.6	88.0	94.5	87.8	4.0	5.5	3.3	4.2	11.7	12.3
France	0.2	0.6	2.8	3.5	1.5	2.0	0.4	0.5	0.4	0.4	1.1	1.2
Netherlands	0.1	0.2	1.0	1.3	1.0	1.3	0.2	0.2	0.1	0.2	0.5	0.6
Germany	0.5	1.4	4.6	6.0	81.8	68.8	0.9	1.2	0.7	0.8	2.6	2.7
Italy	0.2	0.5	77.6	64.0	1.9	2.3	0.5	0.6	0.4	0.4	1.0	1.3
Spain	0.1	0.2	1.0	1.6	0.4	0.7	0.1	0.2	0.1	0.2	0.3	0.3
Belgium	0.1	0.2	0.9	1.1	0.8	1.0	0.2	0.2	0.1	0.2	0.9	0.8
Sweden	0.2	0.2	0.9	0.7	0.7	0.6	0.2	0.2	0.2	0.1	0.5	0.3
Russia	1.0	0.8	0.6	1.2	0.5	1.0	0.3	0.7	0.2	0.4	0.8	0.8
UK	0.2	0.5	1.3	1.6	0.9	1.3	0.5	0.5	0.5	0.5	1.0	1.2
Switzerland	0.1	0.3	0.6	1.1	0.8	1.8	0.1	0.3	0.1	0.2	1.7	1.5
Rest of Europe	0.4	0.8	3.4	5.9	4.1	7.2	0.5	0.9	0.5	0.7	1.3	1.6
NAFTA	2.6	2.1	1.7	2.3	1.7	2.3	92.2	86.0	94.5	90.3	5.1	4.5
USA	2.4	1.6	1.5	2.0	1.5	1.9	89.6	81.3	8.4	9.0	4.4	3.5
Canada	0.1	0.4	0.1	0.3	0.2	0.3	2.3	3.6	86.0	80.9	0.6	0.9
Mexico	0.1	0.1	0.0	0.1	0.0	0.1	0.4	1.0	0.2	0.4	0.1	0.1
Central, South America and the Caribbean	0.4	0.6	0.5	1.1	0.3	0.7	0.9	1.9	0.3	0.7	0.5	0.9
Brazil	0.2	0.3	0.2	0.5	0.2	0.5	0.3	0.6	0.1	0.2	0.3	0.4
Argentina	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1
Rest of countries	0.1	0.2	0.2	0.5	0.1	0.2	0.6	1.2	0.2	0.5	0.2	0.4
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AFRICA	0.2	0.5	0.9	1.5	0.4	0.7	0.3	0.6	0.2	0.3	0.5	0.8
ASIA	93.5	90.3	2.3	6.8	3.0	8.3	2.5	5.7	1.6	4.2	80.9	79.1
China	89.9	82.9	0.5	2.8	0.8	4.2	0.4	2.2	0.3	2.0	1.2	6.0
Hong Kong	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South Korea	0.6	1.7	0.1	0.4	0.2	0.3	0.2	0.4	0.2	0.3	0.7	2.0
Indonesia	0.2	0.8	0.1	0.4	0.2	0.5	0.1	0.3	0.1	0.2	0.6	1.2
India	0.1	0.4	0.1	0.5	0.2	0.7	0.1	0.5	0.1	0.3	1.2	3.7
Singapore	0.1	0.2	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.3	0.7
Japan	2.1	2.4	0.6	0.9	1.0	1.0	1.1	1.0	0.6	0.6	6.6	4.8
Thailand	0.1	0.4	0.1	0.2	0.1	0.3	0.1	0.2	0.1	0.1	67.4	53.7
Viet Nam	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Bangladesh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Turkey	0.0	0.0	0.3	0.3	0.2	0.3	0.0	0.1	0.0	0.0	0.1	0.1
Rest of countries	0.4	1.5	0.4	1.1	0.3	1.0	0.4	0.9	0.2	0.5	2.8	6.7
OCEANIA	0.4	0.8	0.1	0.3	0.1	0.2	0.1	0.3	0.1	0.3	1.4	2.5
Australia	0.3	0.6	0.1	0.2	0.1	0.2	0.1	0.3	0.1	0.2	1.2	2.0
Rest of countries	0.0	0.2	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.4

Source: as described in table (A3.1.1)

Appendix A3.2: Share of Intra-regional and extra-regional value added in regions' final output.

1990									
A3.2.1 North America									
Inter-Regional Value Added Contribution (IRVA)									
	Food & Beverages	**Textiles and Wearing Apparel**	**Wood and Paper**	**Petroleum, Chemical and Non-Metallic Mineral Products**	**Metal Products**	**Electrical and Machinery**	**Transport Equipment**	**Other Manufacturing**	**Total M.**
N. America	0.94	0.91	0.94	0.91	0.92	0.91	0.88	0.92	0.91
Extra-Regional Value Added Contribution									
	Food & Beverages	**Textiles and Wearing Apparel**	**Wood and Paper**	**Petroleum, Chemical and Non-Metallic Mineral Products**	**Metal Products**	**Electrical and Machinery**	**Transport Equipment**	**Other Manufacturing**	**Total M.**
C. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S. America	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01
C. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Asia	0.01	0.03	0.01	0.01	0.02	0.03	0.05	0.02	0.03
S.E. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Europe	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
W. Europe	0.03	0.04	0.03	0.03	0.04	0.04	0.05	0.03	0.04
N.A.M. East	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Sub. S. Africa	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oceania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Extra-Regional Value Added Contribution (ERVA)	0.06	0.09	0.06	0.09	0.08	0.09	0.12	0.08	0.09
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: Author's calculation based on equation (3.1) for the value added decomposition and, equation (3.2) and (3.3) for the inter-regional and extra-regional value added contribution respectively. Geographic country categories as proposed by UNIDO (2016).

2011

North America									
Inter-Regional Value Added Contribution (IRVA)									
	Food & Beverages	**Textiles and Wearing Apparel**	**Wood and Paper**	**Petroleum, Chemical and Non-Metallic Mineral Products**	**Metal Products**	**Electrical and Machinery**	**Transport Equipment**	**Other Manufacturing**	**Total M.**
N. America	0.90	0.84	0.89	0.83	0.85	0.84	0.81	0.86	0.85
Extra-Regional Value Added Contribution									
	Food & Beverages	**Textiles and Wearing Apparel**	**Wood and Paper**	**Petroleum, Chemical and Non-Metallic Mineral Products**	**Metal Products**	**Electrical and Machinery**	**Transport Equipment**	**Other Manufacturing**	**Total M.**
C. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S. America	0.02	0.01	0.02	0.05	0.02	0.01	0.01	0.02	0.02
C. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Asia	0.02	0.04	0.02	0.02	0.04	0.06	0.07	0.04	0.04
S.E. Asia	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
South Asia	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
E. Europe	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
W. Europe	0.04	0.05	0.04	0.04	0.05	0.06	0.07	0.04	0.05
N.A.M. East	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01
Sub. S. Africa	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oceania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROW	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Total Extra-Regional Value Added Contribution (ERVA)	0.10	0.16	0.11	0.17	0.15	0.16	0.19	0.14	0.15
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

1990

A3.2.2 Central America

Inter-Regional Value Added Contribution (IRVA)

	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
C. America	0.80	0.77	0.77	0.73	0.73	0.68	0.63	0.72	0.72

Extra-Regional Value Added Contribution

	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
N. America	0.12	0.12	0.13	0.14	0.13	0.18	0.20	0.14	0.15
S. America	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
C. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Asia	0.01	0.03	0.02	0.02	0.03	0.04	0.06	0.03	0.03
S.E. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Europe	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.00
W. Europe	0.04	0.04	0.04	0.07	0.06	0.07	0.07	0.06	0.06
N.A.M. East	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00
Sub. S. Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oceania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Extra-Regional Value Added Contribution (ERVA)	0.20	0.23	0.23	0.27	0.27	0.32	0.37	0.28	0.28
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

				2011					
Central America									
Inter-Regional Value Added Contribution (IRVA)									
	Food & Beverages	**Textiles and Wearing Apparel**	**Wood and Paper**	**Petroleum, Chemical and Non-Metallic Mineral Products**	**Metal Products**	**Electrical and Machinery**	**Transport Equipment**	**Other Manufacturing**	**Total M.**
C. America	0.79	0.81	0.77	0.73	0.72	0.71	0.64	0.74	0.74
Extra-Regional Value Added Contribution									
	Food & Beverages	**Textiles and Wearing Apparel**	**Wood and Paper**	**Petroleum, Chemical and Non-Metallic Mineral Products**	**Metal Products**	**Electrical and Machinery**	**Transport Equipment**	**Other Manufacturing**	**Total M.**
N. America	0.12	0.09	0.12	0.13	0.12	0.13	0.16	0.12	0.12
S. America	0.03	0.02	0.03	0.04	0.04	0.03	0.04	0.03	0.03
C. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Asia	0.02	0.02	0.02	0.02	0.04	0.04	0.05	0.03	0.03
S.E. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
South Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Europe	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
W. Europe	0.03	0.03	0.04	0.05	0.05	0.06	0.07	0.05	0.05
N.A.M. East	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.00
Sub. S. Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oceania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Extra-Regional Value Added Contribution (ERVA)	0.21	0.19	0.23	0.27	0.28	0.29	0.36	0.26	0.26
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

1990

A3.2.3 South America

Inter-Regional Value Added Contribution (IRVA)

	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
S. America	0.93	0.90	0.92	0.89	0.90	0.86	0.84	0.92	0.90

Extra-Regional Value Added Contribution

	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
N. America	0.03	0.03	0.03	0.04	0.04	0.05	0.06	0.03	0.04
C. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Asia	0.01	0.02	0.01	0.01	0.01	0.03	0.02	0.01	0.01
S.E. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Europe	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.00
W. Europe	0.02	0.03	0.03	0.04	0.04	0.04	0.06	0.03	0.03
N.A.M. East	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sub. S. Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oceania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Extra-Regional Value Added Contribution (ERVA)	0.07	0.10	0.08	0.11	0.10	0.14	0.16	0.08	0.10
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

2011

South America Inter-Regional Value Added Contribution (IRVA)	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
S. America	0.92	0.88	0.89	0.86	0.86	0.81	0.77	0.89	0.86
Extra-Regional Value Added Contribution	**Food & Beverages**	**Textiles and Wearing Apparel**	**Wood and Paper**	**Petroleum, Chemical and Non-Metallic Mineral Products**	**Metal Products**	**Electrical and Machinery**	**Transport Equipment**	**Other Manufacturing**	**Total M.**
N. America	0.03	0.03	0.03	0.04	0.04	0.05	0.06	0.03	0.04
C. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Asia	0.01	0.02	0.01	0.02	0.02	0.04	0.04	0.02	0.02
S.E. Asia	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00
South Asia	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Europe	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00
W. Europe	0.03	0.04	0.04	0.05	0.05	0.06	0.10	0.04	0.05
N.A.M. East	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.01
Sub. S. Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oceania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Extra-Regional Value Added Contribution (ERVA)	0.08	0.12	0.11	0.14	0.14	0.19	0.23	0.11	0.14
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

1990

A3.2.4Central Asia

Inter-Regional Value Added Contribution (IRVA)

	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
C. Asia	0.72	0.73	0.66	0.70	0.69	0.61	0.62	0.70	0.74

Extra-Regional Value Added Contribution

	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
N. America	0.04	0.05	0.03	0.03	0.05	0.07	0.05	0.04	0.04
C. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S. America	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01
E. Asia	0.03	0.04	0.04	0.02	0.04	0.05	0.05	0.04	0.04
S.E. Asia	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01
South Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Europe	0.09	0.06	0.12	0.17	0.11	0.15	0.09	0.10	0.04
W. Europe	0.07	0.05	0.08	0.07	0.06	0.09	0.08	0.06	0.05
N.A.M. East	0.03	0.04	0.03	0.00	0.02	0.00	0.06	0.02	0.04
Sub. S. Africa	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01
South Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oceania	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.00	0.01
ROW	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01
Total Extra-Regional Value Added Contribution (ERVA)	0.28	0.27	0.34	0.30	0.31	0.39	0.38	0.30	0.26
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

2011

Central Asia Inter-Regional Value Added Contribution (IRVA)	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
C. Asia	0.81	0.90	0.68	0.71	0.79	0.70	0.62	0.80	0.82

Extra-Regional Value Added Contribution	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
N. America	0.01	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.01
C. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S. America	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
E. Asia	0.01	0.01	0.02	0.02	0.01	0.02	0.03	0.02	0.01
S.E. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
South Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
E. Europe	0.10	0.04	0.17	0.14	0.13	0.12	0.10	0.09	0.08
W. Europe	0.04	0.02	0.06	0.05	0.04	0.06	0.08	0.04	0.04
N.A.M. East	0.02	0.01	0.03	0.04	0.01	0.06	0.10	0.02	0.02
Sub. S. Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oceania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROW	0.00	0.00	0.01	0.01	0.00	0.01	0.02	0.00	0.00
Total Extra-Regional Value Added Contribution (ERVA)	0.19	0.10	0.32	0.29	0.21	0.30	0.38	0.20	0.18
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

1990

A3.2.5 East Asia

Inter-Regional Value Added Contribution (IRVA)

	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
E. Asia	0.91	0.88	0.91	0.86	0.90	0.90	0.91	0.90	0.90

Extra-Regional Value Added Contribution

	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
N. America	0.04	0.04	0.03	0.03	0.03	0.04	0.03	0.03	0.04
C. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S. America	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
C. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S.E. Asia	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01
South Asia	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Europe	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
W. Europe	0.02	0.04	0.02	0.03	0.03	0.03	0.03	0.03	0.03
N.A.M. East	0.00	0.01	0.00	0.03	0.01	0.01	0.01	0.01	0.01
Sub. S. Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oceania	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01
ROW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Extra-Regional Value Added Contribution (ERVA)	0.09	0.12	0.09	0.14	0.10	0.10	0.09	0.10	0.10
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

2011

East Asia Inter-Regional Value Added Contribution (IRVA)	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
E. Asia	0.90	0.86	0.86	0.79	0.84	0.83	0.85	0.83	0.85
Extra-Regional Value Added Contribution	**Food & Beverages**	**Textiles and Wearing Apparel**	**Wood and Paper**	**Petroleum, Chemical and Non-Metallic Mineral Products**	**Metal Products**	**Electrical and Machinery**	**Transport Equipment**	**Other Manufacturing**	**Total M.**
N. America	0.03	0.02	0.03	0.03	0.02	0.03	0.03	0.03	0.03
C. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S. America	0.01	0.00	0.01	0.01	0.02	0.01	0.01	0.01	0.01
C. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S.E. Asia	0.01	0.02	0.03	0.04	0.02	0.03	0.02	0.03	0.02
South Asia	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.01
E. Europe	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
W. Europe	0.03	0.05	0.04	0.04	0.04	0.06	0.05	0.05	0.05
N.A.M. East	0.01	0.01	0.01	0.05	0.01	0.01	0.01	0.02	0.01
Sub. S. Africa	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Oceania	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01
ROW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Extra-Regional Value Added Contribution (ERVA)	0.10	0.14	0.14	0.21	0.16	0.17	0.15	0.17	0.15
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

1990

A3.2.6 South East Asia

Inter-Regional Value Added Contribution (IRVA)	**Food & Beverages**	**Textiles and Wearing Apparel**	**Wood and Paper**	**Petroleum, Chemical and Non-Metallic Mineral Products**	**Metal Products**	**Electrical and Machinery**	**Transport Equipment**	**Other Manufacturing**	**Total M.**
S.E. Asia	0.87	0.73	0.75	0.72	0.57	0.49	0.64	0.70	0.71

Extra-Regional Value Added Contribution	**Food & Beverages**	**Textiles and Wearing Apparel**	**Wood and Paper**	**Petroleum, Chemical and Non-Metallic Mineral Products**	**Metal Products**	**Electrical and Machinery**	**Transport Equipment**	**Other Manufacturing**	**Total M.**
N. America	0.03	0.04	0.05	0.06	0.05	0.09	0.05	0.05	0.05
C. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S. America	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
C. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Asia	0.04	0.13	0.08	0.10	0.22	0.26	0.19	0.11	0.13
South Asia	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
E. Europe	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01
W. Europe	0.03	0.06	0.08	0.07	0.10	0.12	0.09	0.08	0.07
N.A.M. East	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01
Sub. S. Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oceania	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01
ROW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Extra-Regional Value Added Contribution (ERVA)	0.13	0.27	0.25	0.28	0.43	0.51	0.36	0.30	0.29
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

2011

South East Asia Inter-Regional Value Added Contribution (IRVA)	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
S.E. Asia	0.88	0.73	0.75	0.72	0.57	0.57	0.69	0.68	0.73
Extra-Regional Value Added Contribution	**Food & Beverages**	**Textiles and Wearing Apparel**	**Wood and Paper**	**Petroleum, Chemical and Non-Metallic Mineral Products**	**Metal Products**	**Electrical and Machinery**	**Transport Equipment**	**Other Manufacturing**	**Total M.**
N. America	0.02	0.03	0.04	0.05	0.05	0.06	0.04	0.04	0.04
C. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S. America	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.00
C. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Asia	0.04	0.13	0.09	0.09	0.20	0.21	0.15	0.12	0.12
South Asia	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01
E. Europe	0.00	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01
W. Europe	0.03	0.05	0.07	0.07	0.09	0.10	0.08	0.08	0.06
N.A.M. East	0.01	0.01	0.01	0.03	0.02	0.02	0.01	0.02	0.01
Sub. S. Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Oceania	0.01	0.01	0.02	0.01	0.03	0.01	0.01	0.02	0.01
ROW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Extra-Regional Value Added Contribution (ERVA)	0.12	0.27	0.25	0.28	0.43	0.43	0.31	0.32	0.27
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

1990

A3.2.7 South Asia

Inter-Regional Value Added Contribution (IRVA)

	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
South Asia	0.95	0.93	0.92	0.91	0.91	0.87	0.89	0.87	0.91

Extra-Regional Value Added Contribution

	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
N. America	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.01
C. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Asia	0.01	0.02	0.01	0.02	0.02	0.03	0.03	0.03	0.02
S.E. Asia	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.00
E. Europe	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.00
W. Europe	0.02	0.02	0.03	0.04	0.04	0.06	0.04	0.06	0.04
N.A.M. East	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.00
Sub. S. Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oceania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Extra-Regional Value Added Contribution (ERVA)	0.05	0.07	0.08	0.09	0.09	0.13	0.11	0.13	0.09
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

2011

South Asia Inter-Regional Value Added Contribution (IRVA)	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
South Asia	0.91	0.88	0.84	0.82	0.80	0.74	0.80	0.72	0.81
Extra-Regional Value Added Contribution	**Food & Beverages**	**Textiles and Wearing Apparel**	**Wood and Paper**	**Petroleum, Chemical and Non-Metallic Mineral Products**	**Metal Products**	**Electrical and Machinery**	**Transport Equipment**	**Other Manufacturing**	**Total M.**
N. America	0.01	0.01	0.02	0.02	0.02	0.03	0.02	0.03	0.02
C. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S. America	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.00
C. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Asia	0.02	0.03	0.03	0.04	0.05	0.06	0.05	0.06	0.04
S.E. Asia	0.01	0.01	0.02	0.02	0.01	0.02	0.02	0.02	0.02
E. Europe	0.00	0.01	0.01	0.01	0.02	0.02	0.01	0.03	0.01
W. Europe	0.03	0.04	0.06	0.06	0.06	0.09	0.07	0.09	0.06
N.A.M. East	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.02	0.01
Sub. S. Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Oceania	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
ROW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Extra-Regional Value Added Contribution (ERVA)	0.09	0.12	0.16	0.18	0.20	0.26	0.20	0.28	0.19
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

1990

A3.2.8 Eastern Europe

Inter-Regional Value Added Contribution (IRVA)

	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
E. Europe	0.84	0.75	0.83	0.83	0.84	0.80	0.63	0.82	0.81

Extra-Regional Value Added Contribution

	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
N. America	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03
C. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Asia	0.02	0.03	0.02	0.02	0.02	0.03	0.03	0.02	0.02
S.E. Asia	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
W. Europe	0.08	0.15	0.10	0.11	0.09	0.11	0.28	0.10	0.11
N.A.M. East	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.01
Sub. S. Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oceania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Extra-Regional Value Added Contribution (ERVA)	0.16	0.25	0.17	0.17	0.16	0.20	0.37	0.18	0.19
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

2011

Eastern Europe
Inter-Regional Value Added Contribution (IRVA)

	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
E. Europe	0.83	0.67	0.79	0.80	0.81	0.74	0.49	0.78	0.76

Extra-Regional Value Added Contribution

	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
N. America	0.01	0.02	0.01	0.02	0.01	0.02	0.03	0.01	0.02
C. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S. America	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
C. Asia	0.01	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01
E. Asia	0.02	0.05	0.02	0.02	0.02	0.04	0.06	0.03	0.03
S.E. Asia	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01
South Asia	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.00
W. Europe	0.10	0.20	0.14	0.12	0.12	0.16	0.37	0.14	0.15
N.A.M. East	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Sub. S. Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oceania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROW	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.01
Total Extra-Regional Value Added Contribution (ERVA)	0.17	0.33	0.21	0.20	0.19	0.26	0.51	0.22	0.24
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

1990

A3.2.9 Western Europe

Inter-Regional Value Added Contribution (IRVA)

	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
W. Europe	0.93	0.91	0.94	0.89	0.92	0.91	0.90	0.92	0.91

Extra-Regional Value Added Contribution

	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
N. America	0.02	0.02	0.02	0.03	0.02	0.03	0.03	0.02	0.02
C. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S. America	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Asia	0.01	0.02	0.01	0.02	0.02	0.03	0.03	0.02	0.02
S.E. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Asia	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Europe	0.01	0.02	0.01	0.02	0.02	0.01	0.02	0.02	0.01
N.A.M. East	0.01	0.01	0.00	0.03	0.01	0.01	0.01	0.01	0.01
Sub. S. Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oceania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Extra-Regional Value Added Contribution (ERVA)	0.07	0.09	0.06	0.11	0.08	0.09	0.10	0.08	0.09
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

2011

Western Europe Inter-Regional Value Added Contribution (IRVA)	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
W. Europe	0.88	0.83	0.89	0.81	0.86	0.85	0.83	0.85	0.85
Extra-Regional Value Added Contribution									
	Food & Beverages	**Textiles and Wearing Apparel**	**Wood and Paper**	**Petroleum, Chemical and Non-Metallic Mineral Products**	**Metal Products**	**Electrical and Machinery**	**Transport Equipment**	**Other Manufacturing**	**Total M.**
N. America	0.03	0.02	0.03	0.03	0.03	0.03	0.03	0.02	0.03
C. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S. America	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
C. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Asia	0.02	0.05	0.03	0.03	0.03	0.05	0.05	0.04	0.04
S.E. Asia	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
South Asia	0.01	0.02	0.00	0.01	0.00	0.00	0.00	0.01	0.01
E. Europe	0.02	0.03	0.02	0.04	0.03	0.02	0.04	0.03	0.03
N.A.M. East	0.02	0.02	0.01	0.05	0.01	0.01	0.01	0.01	0.02
Sub. S. Africa	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Oceania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROW	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Total Extra-Regional Value Added Contribution (ERVA)	0.12	0.17	0.11	0.19	0.14	0.15	0.17	0.15	0.15
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

1990

A3.2.10 North Africa and the Middle East

Inter-Regional Value Added Contribution (IRVA)

	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
N.A.M. East	0.87	0.84	0.82	0.83	0.79	0.77	0.72	0.69	0.80

Extra-Regional Value Added Contribution

	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
N. America	0.02	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.02
C. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Asia	0.01	0.02	0.01	0.02	0.03	0.03	0.04	0.03	0.02
S.E. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
South Asia	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
E. Europe	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.03	0.01
W. Europe	0.07	0.10	0.12	0.11	0.12	0.14	0.18	0.20	0.12
Sub. S. Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oceania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Extra-Regional Value Added Contribution (ERVA)	0.13	0.16	0.18	0.17	0.21	0.23	0.28	0.31	0.20
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

2011

North Africa and the Middle East Inter-Regional Value Added Contribution (IRVA)	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
N.A.M. East	0.84	0.73	0.75	0.79	0.77	0.74	0.70	0.59	0.76
Extra-Regional Value Added Contribution	**Food & Beverages**	**Textiles and Wearing Apparel**	**Wood and Paper**	**Petroleum, Chemical and Non-Metallic Mineral Products**	**Metal Products**	**Electrical and Machinery**	**Transport Equipment**	**Other Manufacturing**	**Total M.**
N. America	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
C. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S. America	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01
C. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Asia	0.02	0.04	0.03	0.03	0.03	0.05	0.06	0.04	0.04
S.E. Asia	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
South Asia	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.01
E. Europe	0.01	0.02	0.02	0.03	0.03	0.02	0.02	0.05	0.02
W. Europe	0.07	0.14	0.14	0.10	0.11	0.14	0.16	0.23	0.12
Sub. S. Africa	0.01	0.01	0.02	0.01	0.01	0.01	0.02	0.01	0.01
South Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oceania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROW	-0.01	0.00	-0.01	-0.01	0.00	-0.01	-0.01	-0.01	-0.01
Total Extra-Regional Value Added Contribution (ERVA)	0.16	0.27	0.25	0.21	0.23	0.26	0.30	0.41	0.24
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

1990

A3.2.11 Sub-Saharan Africa

Inter-Regional Value Added Contribution (IRVA)

	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
Sub. S. Africa	0.89	0.75	0.86	0.82	0.80	0.82	0.77	0.83	0.83

Extra-Regional Value Added Contribution

	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
N. America	0.01	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.01
C. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Asia	0.01	0.05	0.01	0.02	0.02	0.02	0.03	0.02	0.02
S.E. Asia	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
South Asia	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00
E. Europe	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.01	0.00
W. Europe	0.05	0.10	0.07	0.09	0.09	0.10	0.12	0.08	0.08
N.A.M. East	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01
South Africa	0.02	0.02	0.02	0.04	0.04	0.02	0.03	0.02	0.02
Oceania	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Extra-Regional Value Added Contribution (ERVA)	0.11	0.25	0.14	0.18	0.20	0.18	0.23	0.17	0.17
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

2011

Sub-Saharan Africa Inter-Regional Value Added Contribution (IRVA)	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
Sub. S. Africa	0.84	0.71	0.80	0.78	0.71	0.74	0.69	0.76	0.77
Extra-Regional Value Added Contribution	**Food & Beverages**	**Textiles and Wearing Apparel**	**Wood and Paper**	**Petroleum, Chemical and Non-Metallic Mineral Products**	**Metal Products**	**Electrical and Machinery**	**Transport Equipment**	**Other Manufacturing**	**Total M.**
N. America	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02
C. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S. America	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
C. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Asia	0.02	0.06	0.02	0.03	0.04	0.04	0.05	0.03	0.03
S.E. Asia	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
South Asia	0.01	0.04	0.01	0.02	0.03	0.01	0.02	0.02	0.01
E. Europe	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
W. Europe	0.06	0.09	0.08	0.09	0.10	0.11	0.13	0.09	0.09
N.A.M. East	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
South Africa	0.03	0.03	0.03	0.04	0.05	0.04	0.04	0.03	0.03
Oceania	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00
ROW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Extra-Regional Value Added Contribution (ERVA)	0.16	0.29	0.20	0.22	0.29	0.26	0.31	0.24	0.23
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

1990

A3.2.12 South Africa

Inter-Regional Value Added Contribution (IRVA)

	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
South Africa	0.90	0.85	0.86	0.84	0.87	0.83	0.67	0.84	0.84

Extra-Regional Value Added Contribution

	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
N. America	0.02	0.02	0.02	0.03	0.02	0.03	0.04	0.02	0.02
C. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S. America	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
C. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Asia	0.01	0.03	0.01	0.02	0.02	0.03	0.06	0.02	0.03
S.E. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Asia	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Europe	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
W. Europe	0.05	0.07	0.08	0.09	0.07	0.09	0.19	0.08	0.09
N.A.M. East	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.01
Sub. S. Africa	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00
Oceania	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
ROW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Extra-Regional Value Added Contribution (ERVA)	0.10	0.15	0.14	0.16	0.13	0.17	0.33	0.16	0.16
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

2011

South Africa Inter-Regional Value Added Contribution (IRVA)	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
South Africa	0.84	0.78	0.80	0.77	0.81	0.77	0.54	0.77	0.76

Extra-Regional Value Added Contribution	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
N. America	0.02	0.02	0.02	0.03	0.02	0.03	0.04	0.03	0.03
C. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S. America	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01
C. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Asia	0.02	0.04	0.02	0.03	0.03	0.04	0.07	0.04	0.04
S.E. Asia	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
South Asia	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
E. Europe	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01
W. Europe	0.07	0.09	0.10	0.11	0.08	0.11	0.25	0.10	0.12
N.A.M. East	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01
Sub. S. Africa	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00
Oceania	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
ROW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Extra-Regional Value Added Contribution (ERVA)	0.16	0.22	0.20	0.23	0.19	0.23	0.46	0.23	0.24
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

1990

A3.2.13 Oceania

Inter-Regional Value Added Contribution (IRVA)

	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
Oceania	0.89	0.88	0.90	0.88	0.90	0.88	0.85	0.88	0.88

Extra-Regional Value Added Contribution

	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
N. America	0.04	0.04	0.03	0.04	0.03	0.03	0.04	0.03	0.04
C. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Asia	0.02	0.03	0.02	0.03	0.03	0.03	0.04	0.03	0.03
S.E. Asia	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
South Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Europe	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
W. Europe	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.03	0.03
N.A.M. East	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Sub. S. Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Extra-Regional Value Added Contribution (ERVA)	0.11	0.12	0.10	0.12	0.10	0.12	0.15	0.12	0.12
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

2011

Oceania Inter-Regional Value Added Contribution (IRVA)	Food & Beverages	Textiles and Wearing Apparel	Wood and Paper	Petroleum, Chemical and Non-Metallic Mineral Products	Metal Products	Electrical and Machinery	Transport Equipment	Other Manufacturing	Total M.
Oceania	0.85	0.83	0.87	0.83	0.86	0.83	0.81	0.84	0.84

Extra-Regional Value Added Contribution	**Food & Beverages**	**Textiles and Wearing Apparel**	**Wood and Paper**	**Petroleum, Chemical and Non-Metallic Mineral Products**	**Metal Products**	**Electrical and Machinery**	**Transport Equipment**	**Other Manufacturing**	**Total M.**
N. America	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.04	0.04
C. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S. America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Asia	0.04	0.05	0.03	0.04	0.04	0.05	0.06	0.04	0.05
S.E. Asia	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
South Asia	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Europe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
W. Europe	0.03	0.04	0.03	0.04	0.03	0.04	0.05	0.04	0.04
N.A.M. East	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.01
Sub. S. Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Extra-Regional Value Added Contribution (ERVA)	0.15	0.17	0.13	0.17	0.14	0.17	0.19	0.16	0.16
Total Value Added (IRVA+ERVA)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: As described in table (A3.2.1)

Chapter 4

Industrial Policy and the Domestic Content of Mexico's Maquila Exports: A long-run Perspective [†,**]

Abstract

This chapter studies the domestic value added content of exports in a developing country, namely Mexico's maquiladoras (export-processing firms) during the period from 1981 to 2006. Initially the government viewed maquiladoras as mere providers of employment. This view and subsequent industrial policies shifted with the increasing outward orientation of Mexico in the late 1980s. The government started to promote the sourcing of intermediates from Mexican firms and technological upgrading within maquiladora firms. We combine a recently released input-output table for maquiladora industries with detailed longitudinal data to study whether observed patterns are related to changes in industrial policy. Over time, productivity and the share of skilled workers in maquiladoras increased only modestly. A long-run decline in aggregate domestic value added embodied in maquila exports, from 31 percent in 1981 to 21 percent in 2006, is largely explained by the falling domestic content within electronics manufacturing. Changes in the domestic content of exports appear mainly related to internal and external shocks and not to changes in the regulatory environment.

JEL Codes: C67, L6

Keywords: Domestic content, Industrial policy, Export processing, Mexico

[†] This chapter has been co-authored with Gaaitzen De Vries (University of Groningen). This chapter is also based on Castillo, J.C. and G.J. De Vries (2018), "The Domestic Content of Mexico's Maquiladora Exports: A Long-Run Perspective", *Journal of International Trade and Economic Developmen*t, 27(2), 200-219. DOI: 10.1080/09638199.2017.1353125

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4.1. Introduction

Mexico's export-processing firms belong to one of the oldest and largest international production networks in the world. The first export-processing firms (officially known as maquiladoras de exportación) were established during the 1960s. Maquiladoras were allowed to import material and equipment without paying tariffs. In combination with low wages, it was very attractive for multinational enterprises to set up an export-processing subsidiary in Mexico. Employment in maquiladoras increased from 0.12 million in 1980 to 1.2 million in 2006. Maquiladoras account for about 20 percent of Mexican manufacturing value added and about half of the country's exports in 2006 (Bergin et al. 2009).

In the 1960s and 70s, many developing countries pursued a development strategy termed import substitution industrialization, which aimed at building a domestic industry behind high tariff walls. The emergence of export-processing firms in Mexico was not in line with this import substitution industrialization. However, the government saw maquiladoras as necessary providers of employment along its Northern border with the United States due to the end of the *bracero* guest-worker program for temporary work of Mexicans in the U.S. (mainly seasonal work in agriculture). Over time, policy makers increasingly realized that maquiladoras not only provide jobs, but are also important for generating foreign currency and for the development of domestic firms that deliver inputs to these maquiladoras. As a result, various policies were put in place during the 1990s to stimulate the technological development of maquiladoras and to increase incentives for sourcing inputs locally (SECOFI, 1994; SECOFI, 1998). These policies aimed to increase the domestic content of maquila production and the creation of good (skilled) jobs. Basically, it is a policy that many developing countries with export processing zones pursue nowadays. Are these changes in industrial policy in Mexico related to changes in the domestic content of exports? Did productivity and the quality of jobs improve within maquiladoras over time?

This chapter is the first study to analyze long-term trends in the domestic content of Mexico's maquila exports. We combine a recently released input-output table for maquiladora industries with detailed longitudinal data on value added, gross exports, employment by skill type, and domestic and imported intermediate inputs to relate observed patterns to changes in industrial policy. Maquiladoras in Mexico predominantly export finished goods (Verhoogen, 2008). This contrasts to a 'typical' firm, which might produce intermediate inputs for use by other firms or sell goods in the local market (and sometimes also the foreign market). In contrast, a maquila firm assembles a good and sells it in the United States.[10] We study whether these maquiladoras upgraded their activities (reflected in an increasing skill content and/or rise in productivity), and increasingly sourced intermediate inputs locally, which could signal the success of industrial policies in stimulating the development of the domestic economy.

[10] Most imports are from the U.S., and over 99.7 percent of sales were in the U.S (Utar and Torres Ruiz, 2013).

Despite various industrial policies, we find that the share of domestic value added in aggregate maquila exports fell from about 31 percent in 1981 to about 21 percent in 2006. However, the domestic content share varies substantially over time. The 1982 debt crisis and the 1994 Tequila crisis together with the run-up and adoption of the North American Free Trade Agreement (NAFTA) during the early 1990s coincide with declines in the domestic content. The emergence of China, especially after its entry to the WTO in 2001, appears related to a gradual decline in the domestic value added of aggregate maquila exports. A decomposition analysis suggests that this is partly driven by the demise of textile manufacturing that has a relative high domestic value added content. However, the overall long-run decline in the aggregate domestic value added embodied in maquila exports, is largely accounted for by the falling domestic content within electrical machinery product manufacturing.

Research that studies the export composition of Mexico typically finds that the technology composition of Mexico's exports increased substantially, because it transformed from one based on raw materials to one dominated by medium- and high-technology manufactured products during the past decades (Sturgeon and Gereffi, 2009). This suggests learning and industrial upgrading is taking place in Mexico. However, to assess whether the transformation is real and not just a shift towards other final assembly activities, one need know the value that is added in production by a country, rather than the gross output value of its exports, which is the approach taken in this paper. So far, most analysis of the domestic content embodied in exports and technology upgrading within maquiladoras has been limited to surveys and case studies. These studies provide a rich characterization of maquila firms, but it is unclear whether these findings can be generalized. We aim to provide a macro perspective to these case studies. A clear limitation in this approach, however, is that we are unable to causally link industrial policy to the domestic content of exports. We will relate industrial policies to changes in the domestic content, but more detailed and novel identification strategies are required to causally link policy and the domestic content.

Our chapter is most closely related to de la Cruz et al. (2011, 2013).[11] De la Cruz et al. (2011, 2013) measure the domestic content of Mexico's exports for the period from 2000 to 2006. Similar to this paper, they use the 2003 input-output table that distinguishes processing and non-processing activities. Their results for the domestic content share in Maquiladora exports in 2003 are fairly similar. Compared to de la Cruz et al. (2011, 2013), changes during 2000-2006 in the domestic content are only due to variation in the export composition. In contrast, in this paper we do collect and use information on production and inputs. Hence we allow the domestic content to vary if input cost shares change over time, which is more accurate. The purpose of de la Cruz et al. (2011, 2013) is also different from ours. They aim to provide point estimates for the domestic content in Mexico's processing and non-processing exports and compare these to those for China. In comparison, this chapter aims to relate changes in the domestic content of maquiladora exports to changes in industrial policy. We take a much longer time perspective, from 1981 to 2006. Industrial policies changed in important ways

[11] See also Johnson and Noguera (2012) who separate the value added content of Mexico's maquila and non-maquila exports for the year 2004.

during the 1980s and 90s (as we will discuss in section 4.2), so a long-run approach is necessary in order to relate changes in the domestic content of exports to changes in industrial policy. Changes in the domestic content of exports are one way to examine whether industrial upgrading is taking place. Typically, if activities shift to higher value adding stages of production (say from assembly to product development), we also expect these shifts to be accompanied by an increase in skills and capital. In contrast to de la Cruz (2011, 2013), we therefore also examine the productivity performance of maquiladoras and explore changes in the share of non-production workers over time.

The remainder of the paper is organized as follows. In the next section (4.2), we give an overview of industrial policies for the maquila industry from its inception in the 1960s until the merging of the program in a broader framework in 2006. We argue that industrial policy changed considerably as time progressed, but there is little evidence to guide us whether these policies had their intended effects. In section 4.3, we discuss the data and provide a descriptive analysis of changes in the use of domestic intermediate inputs by maquiladoras, as well as productivity growth and the use of skilled workers within maquiladoras. We also examine changes in the industry composition from 1981 onwards. Section 4.4 discusses the estimation of time series input-output tables and describes the method to measure the domestic value added content of exports. Section 4.5 presents empirical results and it returns to a discussion of industrial policies related to changes in the share of domestic content in maquiladora exports. Section 4.6 provides concluding remarks.

4.2. Industrial Policy and Mexican Maquiladoras: an Overview

The maquiladora program was devised in the 1960s as an emergency program to cope with rising unemployment observed in the northern part of Mexico. Mexicans were pushed out of the United States due to end of the *bracero* guest-worker program in 1964. Initially, the maquila program was restrictive (Contreras and Munguía, 2007). For example, firms were supposed to be located within 20 kilometers of the Mexican border; have a minimum national ownership of 51 percent; and they had the obligation of re-exporting their entire production. This restrictive legal framework was put in place, because the program was not in line with the Import Substitution Industrialization (ISI) policies prevailing in Mexico at the time. Providing tariff exemptions to manufacturing firms that are partly foreign owned was simply a policy contrary to the strategy of ISI. As a consequence of this ISI, the government of Mexico hardly implemented policies related to firms operating under the maquiladora program.

During the 1970s, several laws were passed that aimed to reduce unemployment, by permitting the creation of maquiladoras in coastal areas (in 1971), and soon thereafter for the entire Mexican territory (in 1972). Yet most maquiladoras remain along the Northern border of Mexico to avoid higher transport costs. In 1977 a law was passed that allowed maquiladoras to be completely foreign owned (Urias, 1978). Few attempts were made to promote technological upgrading within maquilas and to increase the domestic content of production however. To the contrary, regulations implemented by the Mexican general Law on Foreign Investment in 1973, allowed the government to review and control the implementation of technologies in maquiladoras. Also, the government was able to prohibit any foreign firm or new plant from entry if it could harm the national industry (González, 1990). These policies limited the possibility of industrial upgrading as it posed restrictions to the implementation of foreign technologies.

In the mid-1980s, as many Latin American countries (including Mexico) struggled with the debt crisis, Mexico's policies became more outward-oriented and various market-oriented reforms were implemented. A key policy change was Mexico joining the General Agreement on Tariffs and Trade (GATT) in 1985, which served as an initial push for domestic and international trade reforms during the upcoming years. Once this new economic model was established, major changes were seen in the legal framework for maquiladoras. The government recognized the potential of maquila firms as one of the drivers of the new export-led development in Mexico. According to new regulations that were passed in 1989 (see Government of Mexico, 1989), the maquiladora industry was now supposed to meet the following objectives: (1) to provide higher levels of employment; (2) to increase manufacturing exports and levels of foreign exchange; (3) to stimulate the development and transfer of knowledge and; (4) to promote investment in human capital through further integration with the local Mexican manufacturing industry.

Various researchers have studied the effects of these new government objectives, but so far this has been restricted to selected sectors. For example, Wilson (1992) and Carrillo and Hualde (1997) study changes in the technology used in automotive and electronic manufacturing during the 1980s. They find that new technologies were typically introduced to obtain more precision, control and quality at labor-intensive activities. Hence, old machinery was replaced by technologically more sophisticated instruments that still needed a low qualified workforce to operate (Carrillo and Hualde, 1997). Also, more autonomous decision making was observed, but this remained restricted to issues such as recruitment and human resource management. Hardly ever did local managers participate in the selection of inputs or in the decision process of goods to be produced as most of the technical specifications came from abroad. Along the same lines, local management had little influence on investment, finance or production technology decisions (Wilson, 1992).

Output and employment expanded fast during the 1990s. And as we will describe below, the composition of output increasingly shifted towards the production of electronic and transport equipment goods. This growth was underpinned by legal changes that were in line with the liberalization of the economy. For instance, the new Law on Foreign Investment of 1990 represented a major relaxation of policies towards foreign direct investment relative to that of 1973, because it reduced uncertainty and allowed for long term planning of operations. This new regulation was thought to induce a change in current corporate strategies of foreign firms under the maquila program so that they could develop progressively more technologically complex activities in the country, moving away from the labor intensive ones (Carrillo, 2007). Along the same lines, import licensing continued to decline in importance and easier and faster administrative procedures were implemented.[12]

In 1994, the removal of trade and investment barriers in the North American Free Trade Agreement (NAFTA) gave rise to another output boost for maquila industry. The NAFTA agreement increased the preferential access of maquiladoras to the US market relative to firms outside the NAFTA area due to the execution of the principles of national treatment and most-favored-nation (NAFTA Article 102). Non-NAFTA originated inputs had to pay Mexico's Most Favored Nation (MFN) tax, around 35 percent in 1994, while the intermediate goods originating in the NAFTA region could be imported free of duty. Hence, these new regulations created an important incentive for the production of parts and components in maquiladoras because the inputs eligible for the tariff exemption were not only those including pure NAFTA content, but also those from other regions that have been previously processed in Mexico.[13] In addition, with the NAFTA agreement, the benefits to maquila firms were extended to companies that supplied them goods and services thereby increasing the incentive for domestic firms to supply maquiladoras.

As a result of this changing economic environment in Mexico, maquiladoras started to introduce more technologically complex procedures. Buitelaar and Padilla (2000) argue that modern management systems were more commonly seen in maquiladoras, such as total quality control, just in time delivery, elaborate operation manuals as well as norms regarding organizational culture and labor discipline. In addition, they find that more skilled workers were employed and they observe an increase in local R&D centers. However, these results are based on a case study and it remains to be seen whether technological upgrading is a general pattern.

A large contraction of output and employment in the maquiladora industry occurred during the early 2000s. This was in part due to the 2001 recession of the US economy with the collapse of the dot-come bubble, and in part due to the industrial emergence of China and its entry to the WTO in 2001. China's emergence has had a profound negative effect on maquiladoras. The reason for this negative effect is often sought in the similarity of the composition of US imports from Chinese and Mexican producers (Dussel Peters, 2005; Gallagher et al., 2008).

In light of increasing competition, the government of Mexico implemented more changes in the legal framework that aimed to induce an increasing number of maquiladoras to

[12] At the same time, other export promoting programs for the manufacturing industry were implemented. In 1985, the "Programas de Importación Temporal para Producir Articulos de Exportación" (PITEX) came into effect with the intention of permitting exporting firms in domestic manufacturing to import intermediate inputs and machinery free of duty as long as 30% of their total sales were exported. As discussed in chapter 2, one of the difference between the firms under PITEX and the maquiladora program lies in the fact that the industries under the latter program were exempted to a bigger amount of taxes. Similarly, unlike maquiladoras, PITEX firms were mainly located in the interior of Mexico as most of their production was destined for domestic consumption (de la Cruz et al., 2011).

[13] As of 2001, only North American inputs were exempted from tariffs. In order not to lose competitiveness, policy makers implemented a new program called "Sectoral Programmes" (PROSECs) that provided tax exemption to the import of a specific percentage of inputs not produced in North America across selected industries.

exit low-tech, labor intensive industries and evolve toward higher value added, technology intensive sectors (Sargent and Mathews, 2008). During the early 2000s, the government provided substantial tax incentives to maquiladora firms that engaged in research and development activities (R&D) and created a fund to promote Mexico's software industry (Ruiz Durán et al., 2005). State governments, industry chambers, and universities were also involved in the upgrading efforts. The branch of Mexico's largest private university system in Guadalajara established institutes designed to accelerate the development of design engineering centers, software development firms, and technology intensive startups in the city's cluster of electronics firms. The government in Mexico was especially interested in attracting new companies engaged in applied research, product and process development, product testing, and high-tech manufacturing in five industries; biotechnology, mechatronics, information technology, health, and nanotechnology (Sargent and Mathews, 2008).

In a nutshell, Mexico's industrial policy towards maquiladoras gradually shifted from viewing them as mere providers of employment towards promoting the sourcing of intermediates from upstream domestic firms and technological upgrading within maquiladora firms. In the next section we discuss the dataset to that will be used to analyze whether these policy changes had their intended effects.

4.3. Database Construction and Descriptive Statistics for Maquila Industries

The dataset for detailed maquiladora manufacturing industries consists of longitudinal information on output (gross output and value added), gross exports, as well intermediate inputs and employment distinguished by production and non-production workers. This data is derived from various publications by the statistical office (INEGI 1991, 2001, 2005). The data presented in these publications are based on the monthly statistical surveys for the maquiladora industry as well as the five-yearly economic census. The monthly sample survey of the maquiladora industry collects detailed information on the business operations of maquilas. The setup of the survey has not changed much during the period analyzed, and the economic census is a full census of economic activity that underpins this monthly survey. Data from 1990 to 2006 can be readily obtained from the national statistical office's website (www.inegi.org.mx), but to trace the development further back and to obtain more industry detail, we collected and digitized hard copies of various reports (notably INEGI 1991, 2001). Detailed industry data following Mexico's industry classification is matched to two digit industries in the International Standard Industrial Classification 3.1.[14]

After 2006, the maquiladora program was merged with another program that offers duty relief for temporary imports, the PITEX program (Programas de Importación Temporal para Producir Articulos de Exportación). As a result, the statistical office no longer updates information for maquiladoras. Information that includes maquiladoras

[14] Our analysis starts in 1981 as we were unable to obtain industry level data further back. The Maquiladora program started in the 1960s, but it only started to boom with the increasing outward orientation of Mexico during the late 1980s (Feenstra and Hanson, 1996). We believe the time period included in this chapter captures the most important periods in the history of the Maquiladora program.

and other firms is reported in the monthly statistical report of the IMMEX program from 2006 onwards (Industria Manufacturera, Maquiladora, y de Servicio de Exportación). Our time series stop in 2006, because it is not possible to distinguish maquiladora firms in these reports. Also, policies specific to maquiladoras are no longer present from 2006 onwards. Thus we focus on the domestic content of maquila exports in the period from 1981 to 2006.

Columns (1) – (4) of table 4.1 show gross output shares by industry for 1981, 1990, 2000, and 2006. Note that gross output equals exports for maquiladoras since we assume that everything produced is subsequently exported (this is further discussed in section 4.4). Changes in gross output shares reflect changes in the industry composition. Textile products, electronics, and transport equipment account for the majority of gross output, with the assembly of electronic goods by itself accounting for over half of the gross production value.[15]

During the 1980s, transport equipment and miscellaneous manufacturing (including furniture, jewelry, musical instruments, sports goods and toy production) grew substantially faster as compared to other sectors such as textiles and electronics. The opposite pattern is observed for the 1990s. After 2000 we observe a sharp drop in the relative importance of textile manufacturing. This drop might be related to the entry of China to the WTO in 2001 and the end of the Multi-Fiber Agreement in 2004 that eliminated import quotas for textile products. Mexican textile firms faced relatively tough competition from Chinese firms thereafter. These import competition effects in the US market are likely to differ across industries, for example due to quality differences and transport costs, but also firm size within industries (Iacovone et al. 2013).

Changes in the relative size of sectors carry important implications for the composition of maquila exports and subsequently also for the domestic value added content of exports. In column (5) we report the share of domestic intermediate inputs in total intermediate inputs in 2006. The share of domestic intermediates varies substantially across industries. Food processing manufacturing is sourcing a lot of inputs domestically (37.9 percent in 2006) as fresh produce typically requires immediate processing. However, most inputs in the more technologically advanced electronics manufacturing sector are sourced from abroad. The domestic share is only 6.8 percent in 2006. The share of domestic inputs directly used in production reflects the direct domestic content of maquila exports. Hence, the relative decline of textile manufacturing with a high share of domestically produced intermediates and the relative expansion of electronics and transport equipment manufacturing with a low domestic content after 2000 suggests that the domestic content in aggregate exports declined. We will examine this more formally in section 4.5.

[15]"Business services" includes activities such as "professional services", "leisure services" and "other services". These services are provided by some maquiladoras (INEGI, 2010).

Table (4. 1): Descriptive Statistics, Size and Domestic Input use for Maquiladora Industries.

	Gross output shares				Domestic intermediate use shares
	1981	1990	2000	2006	2006
	(1)	(2)	(3)	(4)	(5)
Food, Beverages and Tobacco	1.9	1.1	0.4	0.8	37.9
Textiles and Textile Products	15.5	7.4	12.0	7.4	16.0
Leather, Leather and Footwear	1.0	1.0	0.6	0.3	16.0
Pulp, Paper, Printing and Publishing	1.5	3.6	2.0	1.9	17.7
Chemicals and Chemical Products	-	0.3	0.2	0.2	35.1
Rubber and Plastics	2.3	1.6	2.2	3.1	22.9
Other Non-Metallic Minerals	0.4	0.6	0.7	1.9	10.5
Basic Metals and Fabricated Metal	2.4	3.1	3.1	3.2	21.4
Machinery	1.8	2.0	1.8	2.3	17.3
Electronics	55.3	45.9	52.9	53.0	6.8
Transport Equipment	11.4	22.5	16.5	17.2	14.2
Miscellaneous manufacturing	2.3	9.7	6.1	6.9	10.1
Business services	4.2	1.3	1.5	1.8	24.5
Total	100.0	100.0	100.0	100.0	10.9

Notes: Columns (1) – (4) show gross output shares in current prices by industry. Column (5) shows the share of domestic intermediate inputs in total intermediate inputs. Total refers to total maquila industries. Wood and Products of Wood and Cork is included in Pulp, Paper, Printing and Publishing manufacturing.
Sources: INEGI (1991, 2001, 2005) and others, see text.

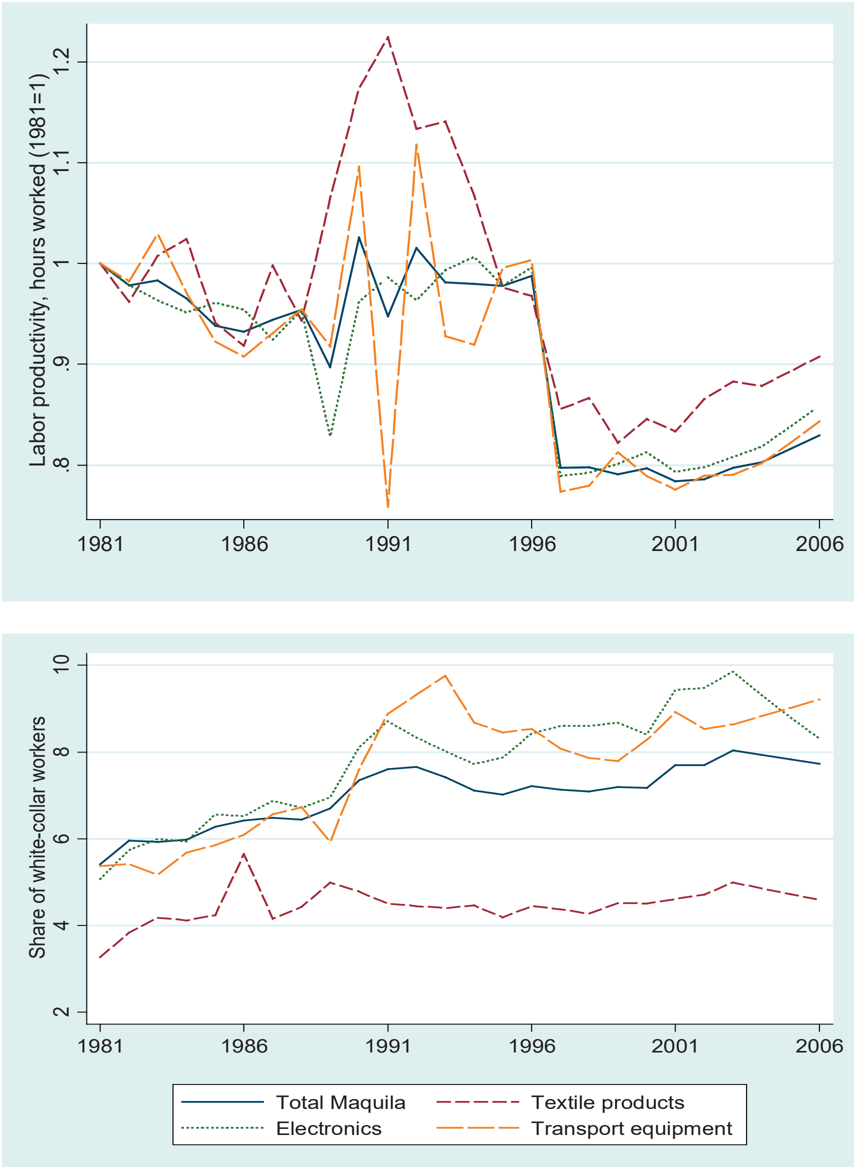
Figure 4.1 shows various indicators of technological development within maquila manufacturing industries. The top panel shows productivity growth for total manufacturing and the three largest sectors (textile, electronics, and transport equipment manufacturing). We divided real value added by hours worked to measure labor productivity. Based on growth rates of labor productivity an index is constructed, which equals 1 in 1981. The overall trend suggests that productivity hardly improved during the period considered. In 1997 there is a substantial drop in labor productivity, which arises from a substantial increase in hours worked between 1996 and 1997. In 1997, there is a substantial drop in labor productivity, which arises from a new tax regulation imposed on the profits earned by maquiladora firms.[16] From the late 1990s onwards, productivity modestly improved.

The dataset we constructed distinguishes between production workers and non-production workers. Production workers mainly undertake manual tasks, whereas non-production workers mainly undertake managerial and administrative tasks. The bottom panel of figure 4.1 shows the share of non-production workers in total persons engaged, which proxies for the quality of jobs. The figure reveals that more technology intensive

[16] As mentioned in Chapter 2,before 1995, maquila firms paid little (or any) income and asset taxes because they were not operating as profit centers, and often leased machinery and equipment (Rice, 1998). After 1995, as a result of the boom in production triggered by NAFTA, the Mexican government no longer regarded maquila firms as cost centers but as profit centers. Thus, in the following years, maquiladoras were required to report arm's-length profits or to meet a safe harbor for tax purposes (PWC, 2013). In general, the main implication behind this policy shift was that maquilas were now supposed to pay income taxes on the basis of their profits just like any other manufacturing firm in Mexico (Gambrill, 2002).

sectors such as electronics and transport equipment manufacturing have a higher share of non-production workers compared to less technology intensive sectors such as textile manufacturing. A slightly upward trend, though from low initial levels, can be observed.

Figure (4. 1): Productivity Growth and Share of non-Production Workers, 1981-2006.



Notes: The first panel shows productivity growth, which is based on the growth in real value added divided by persons engaged (the index equals 1 in 1981). The second panel shows the percentage share of non-production (white-collar) workers in total persons engaged. *Sources*: INEGI (1991, 2001, 2005) and others, see text.

Overall, however, the modest positive trend in labor productivity and the small increase in non-production workers suggest that technological development in the maquiladora industry has not advanced at a fast pace. In the next sections we will study whether the domestic content of exports has increased. We first outline the input-output table and the method to measure the domestic content of exports before turning to the empirical analysis.

Our preferred method (explained in the next section) to measure the direct and indirect domestic input content embodied in maquila exports requires an input-output table. INEGI recently released such a table for the maquila industry for the year 2003 (INEGI, 2010). Although total economy input-output tables are available for Mexico as well, the use of such tables would introduce a bias in the measured domestic content if the sourcing structure differs across maquiladora and non-maquiladora exporting firms. Dietzenbacher et al. (2012) show how this sourcing structure differs between processing and non-processing firms in China.

The maquiladora input-output table is constructed on the basis of a Supply and Use Table (SUT) at basic prices and additional assumptions concerning technology. To transform the SUT in an industry by industry Input Output Table (IOT), we use the so-called "fixed product-sales structure" assumption stating that each product has its own specific sales structure irrespective of the industry where it is produced. The sales structure assumption refers to the proportions of the output of the product in which it is sold to the respective intermediate and final users. This assumption is most widely used to transform SUTs into IOTs, not only because it is more realistic than its alternatives, but also because it requires a relative simple mechanical procedure. Furthermore, it does not generate any negatives in the IOT that would require manual rebalancing (see Miller and Blair (2009) for further discussion).

In constructing the maquila SUT, INEGI relies on various internal and externally available statistical sources. The main source for production data is the Monthly Statistical Report for the Maquiladora Industry undertaken by INEGI. This information is combined with the Foreign Trade Database prepared by the Central Bank of Mexico, which contains information on imported intermediate consumption. Trade margins (the difference between products valued at producer and purchasers' prices) are estimated from the 2004 Commercial Census. Gross value-added is the sum of the wage bill, net taxes on subsidies from production and the gross operating surplus. The "National Survey of Employment for 2003" prepared by INEGI in conjunction with the Monthly Statistical Report was the underlying source of information for these data. For further details on the methods and sources, see INEGI (2010).

4.4. Methodology to Measure the Domestic Content of Exports Over Time

This section is divided in two parts. First, we outline the method to measure the domestic content of maquila exports. Second, we discuss the (G)RAS procedure to estimate time series input-output tables for Mexico.

4.4.1 Measuring the Domestic Content of Maquila Exports

We use the approach from Los et al. (2016) to measure Mexican value added embodied in maquila exports. There is a big debate in the literature about how to measure domestic value added in gross exports in global or inter-regional input-output tables, and various methods are proposed (see e.g. Daudin et al. 2011; Johnson and Noguera, 2012; Foster-McGregor and Stehrer, 2013). In an influential article, Koopman, Wang, and Wei (2014) provide a complete decomposition of the gross exports value of a country into nine terms, based on an input-output representation of the world economy. However, their accounting approach is mathematically tedious. And a key issue in that paper concerns what to do with the so-called 'pure double counted' terms in measuring the domestic content of exports. When there is two-way trade in intermediates, meaning that country A needs inputs from country B to produce inputs for B, it is typically difficult to establish the origin of these pure double counted terms. Conceptually tables can be constructed that trace this two-way trade, but empirical input-output tables will never have the required level of detail and it is hard to imagine they ever will, given the amount of information that would be needed. It implies that *all* tasks in *all* supply chains in the world should be represented as separate industries.

Los et al. (2016) introduce an elegant and intuitive method to measure domestic value added in gross exports. They extract all export flows from a country and calculate how much value added would be generated in that hypothetical situation. Domestic value added in exports is defined as the difference between actual and hypothetical GDP in that country. They show their measure is equal to the first five terms in the key equation (36) of Koopman et al. (2014). These five terms in Koopman et al. (2014) do not include any pure double counted terms. In addition, Los et al. (2016) show that their and Koopman et al. (2014) measure of domestic value added in exports is equal to one minus Vertical Specialization (VS), with VS as originally suggested by Hummels, Ishii and Yi (2001). In what follows we write down formally how we measure Mexican value added in maquiladora exports.

Consider n industries and let the matrix $\mathbf{Z}$ denote domestic inter-industry flows from industry i to industry j. The vector of exports is denoted by $\mathbf{e}$, the final demand vector by $\mathbf{f}$, the vector of value added by $\mathbf{v}$, the vector of industry gross outputs by $\mathbf{x}$, and let $\mathbf{M}$ denote the import use matrix with a typical element m_{ij} the imports of industry i by industry j.

The domestic and imported intermediate input flows for both domestic and maquila industries can be depicted in an adaptation of the ordinary input-output table, see table 2. The framework is similar to an inter-regional input-output table, with two regions. In this table, the matrix $\mathbf{Z}^{DD}$ gives domestic industry deliveries to other domestic industries, whereas $\mathbf{Z}^{DP}$ gives domestic inter-industry flows to maquila industries. Likewise, the vector $\mathbf{v}^{D}$ gives value added generated in domestic industries whereas $\mathbf{v}^{P}$ gives value added in maquila (export-processing) industries.

Note that maquila firms in the final use block are assumed not to deliver output for final demand ($\mathbf{f}^{p}$ = 0, see table 4.2). INEGI (the national statistical office of Mexico) regularly carries out surveys, and consistently finds that maquiladoras sell less than 5% of their output domestically (Verhoogen, 2008). Some of these domestic sales of maquiladoras may end up as intermediate inputs for domestic firms (which would be in the matrix $\mathbf{Z}^{PD}$, here set to zero). We are unable to take these intermediate transactions into account and this will result in a bias in our estimates. However, given the typically low value of these transactions we presume this bias will not be large. We also assume $\mathbf{Z}^{PP}$ is zero, hence no intermediate deliveries amongst maquiladoras, but below discuss an approach to infer the bias from this assumption.

We assume that maquila output is exported, so gross output of maquila firms equals gross exports. This is consistent with procedures at the statistical office INEGI, who give the estimates for the maquiladora industries that are compatible with the Mexican Balance of Payments. In the Mexican BOP, gross output equals gross exports and imported intermediate inputs equals the total value of maquila imports such that the difference is the maquiladora trade balance.

Table (4. 2): **Expanded Input-Output Table for Mexico.**

	Intermediate use		Final use		
	D	*P*	*FD*	*EXP*	*TOT*
D	$\mathbf{Z}^{DD}$	$\mathbf{Z}^{DP}$	$\mathbf{f}^{D}$	$\mathbf{e}^{D}$	$\mathbf{x}^{D}$
P	0	0	0	$\mathbf{e}^{P}$	$\mathbf{x}^{P}$
IMP	$\mathbf{M}^{D}$	$\mathbf{M}^{P}$	$\mathbf{f}^{M}$	0	$\mathbf{x}^{M}$
VA	$(\mathbf{v}^{D})'$	$(\mathbf{v}^{P})'$			
TOT	$(\mathbf{x}^{D})'$	$(\mathbf{x}^{P})'$			

Notes: D = industries producing for domestic use; P = maquila industries (export processing); FD = final demand; EXP = exports; TOT = gross industry outputs (and total imports in the column TOT); IMP = imports; and VA = value added.

The direct requirements for domestic input *i* per unit of output *j* are given by $\mathbf{A^{DD}} = \mathbf{Z^{DD}}\ (\widehat{\boldsymbol{x}^{\boldsymbol{D}}})^{-1}$ for domestic industries (with typical element $a_{ij}^{DD} = z_{ij}^{DD}/x_j^D$) and $\mathbf{A^{DP}} = \mathbf{Z^{DP}}\ (\widehat{\boldsymbol{x}^{\boldsymbol{P}}})^{-1}$ for maquila industries.[17]

Production typically requires domestic and imported inputs. However, these inputs in turn also require domestic and imported inputs. The latter effects are indirect effects. The size of these indirect effects depends on the interrelatedness of production across industries and countries. To include both direct and indirect effects in an analysis of the domestic content of exports, we calculate the total effect using the Leontief inverse $\mathbf{L} = (\mathbf{I} - \mathbf{A})^{-1}$, where $\mathbf{I}$ is the identity matrix, a diagonal matrix of ones.

The total domestic content of aggregate maquila exports is one minus VS as in Hummels et al. (2001), which is given by

$$DCE = (\boldsymbol{v})'(\boldsymbol{I} - \boldsymbol{A})^{-1}\boldsymbol{e}^P/(\boldsymbol{u}'\boldsymbol{e}^P), \qquad (4.1)$$

[17] The circumflex indicates a diagonal matrix, in this case with the vector $\mathbf{x}$ on the main diagonal.

We will use equation (4.1) to calculate the Domestic Content of maquila Exports (DCE). By observing the variables included in equation (4.1), the reader should notice that our proposed measure of DCE includes the joint value added contribution from maquila and domestic producers; $\boldsymbol{v}$ is a row vector that contains information on the value added coefficients for maquila and for the domestic sector, respectively (as described in table 4.2); $\boldsymbol{A}$ is the full leontief matrix which separately includes all the available information for the direct requirements for domestic input *i* per unit of output *j* as suggested in table 4.2. This means that $\boldsymbol{A}$ separately includes $\mathbf{A^{DD}}$, $\mathbf{A^{DP}}$ as well as $\mathbf{A^{PD}}$ and $\mathbf{A^{PP}}$. Given that, by definition, maquiladora firms do not produce intermediate inputs, matrices $\mathbf{A^{PD}}$ and $\mathbf{A^{PP}}$ (included in $\mathbf{A}$) are only consistent of zeros. In addition, the information for column $\boldsymbol{e}^D$ in total column $\boldsymbol{e}$ (again in table 4.2) is set to zeros in order to only compute value added embodied in maquila exports. The entire latter column represents the information contained in $\boldsymbol{e}^P$ at equation (4.1). Finally, $\mathbf{u}$ is a summation vector consisting of ones, and a prime (e.g. $\mathbf{u}'$) indicates transposition.

In order to measure DCE annually from 1981 to 2006 by means of equation (4.1), we need a time series of the expanded input-output table as shown in table 4.2. This objective will be met in the next sections.

4.4.2. Construction of Time Series IOTs.

For the purposes of this chapter, we will extrapolate the official intermediate use tables for maquiladora and for the domestic sector that were produced for 2003. Extrapolating these official tables (which are also available for domestic and imported intermediate use) would allow us to fill the different set of matrices shown in table 4.2 (namely $\mathbf{Z}^{DD}$, $\mathbf{Z}^{DP}$, $\mathbf{M}^{D}$, $\mathbf{M}^{P}$) for the period from 1981 to 2006. To do so, the literature offers a wide pallet of methods to project IOTs for non-benchmark years. Temurshoev et al. (2011) provide an overview and asses the performance of various projection methods. They find that (G)RAS gives one of the most reliable projections of the data. We use the iterative algorithm of (G)RAS proposed by Lenzen et al. (2007). Basically, the G-RAS procedure requires a benchmark input-output table and row and columns sums for all years for which we would like to estimate IOTs. (G)RAS estimates new IO matrices for all years as close as possible to the benchmark table under the external constraints of the row and column sums.

Yearly data on domestic and imported intermediate consumption reported at the sub-sectoral level (as described in section 4.3) for maquila and domestic firms will act as our external constraint of the row and column sums as required by the (G) RAS procedure. Additional yearly official information on gross output, final demand, gross value added reported at the sub-sectoral level (also described in section 4.3) will be used to fill the vector cells required in table 4.2

While the (G)RAS approach allows us to project IOTs for non-benchmark years, an important limitation that we face is the absence of benchmark tables for earlier years. Our approach takes into account differences in the overall structure of the maquila and domestic industries, but if intermediates sourcing structures change substantially over time, these changes are not necessarily well accounted for. Temurshoev et al. (2011) asses the bias in projecting supply and use tables (the building blocks for IOTs) for Spain and the Netherlands. That is, they project a table to a particular year, say 2000 and compare the projected table with the officially published table from 2000. A five-year projection of the use table (projecting for 2000 using a 1995 benchmark table) results on average in about a 9 percent margin of error for any particular element in the use table.[18] A ten-year projection of the use table gives an almost 18 percent margin of error, almost twice as large. If this carries over to our context, our projection for the earliest year in our sample – 1981 - based on the 2003 benchmark table may have a 40 percent margin of error. This is a substantial error margin and it might be even larger in our projections considering the more volatile development path in Mexico compared to Spain and the Netherlands on which the estimates by Temurshoev et al. (2011) are based. It is a serious limitation of the analysis presented here, and we will get back to this when discussing the results, in particular for the early 1980s. However, our approach is not uncommon in the literature. See e.g. Johnson and Noguera (2014) who estimate global input-output tables backwards for four decades. Also, one reason why we presented measures of upgrading such as productivity growth rates and the share of non-production workers in section 4.3 was to back up our key finding, namely that the domestic content of maquiladora exports has been in a long term decline. In addition, in the next section we seek to relate several sector-specific findings to sector-specific policies to be more certain that we are capturing something real and not just measurement error.

4.5. The Domestic Content of Maquila Exports

In this section we describe the evolution of Mexico's value added share in maquila exports for the period from 1981 to 2006. In section 5.1 we document aggregate and industry trends. Subsequently we examine whether changes in the aggregate trend are driven by changes within industries or by changes in the industry composition in section 5.2.

4.5.1 The Domestic Content of Maquila Exports: Aggregate and Industry Trends

The share of domestic content in aggregate exports is shown in figure 4.2. We use the extended input-output tables and equation (4.1) to calculate domestic content for the period from 1981 to 2006. The figure reports the total domestic content, which incorporates indirect effects, because for the production of domestic intermediates also imported inputs are used. In 1981, the domestic content share in Mexico's maquila exports is about 31 percent. In 2006 this share has fallen to about 21 percent. Even if we ignore the turbulent early 1980s, our findings suggest that the domestic content was between 25 and 20 percent. This suggests the domestic content of maquila exports has declined substantially.

Buitelaar and Perez (2000) use detailed firm-level studies to explain why local firms supply so few inputs to maquiladoras. They argue that part of the low domestic content embodied in maquila exports relates to the regulatory environment that did not

[18] This is based on a weighted absolute percentage error, which weights each percentage deviation of a cell element in the use table from the true element by the relative size of the corresponding true element in the overall sum of the actual elements. We discuss the weighted absolute percentage error for its simplicity in interpretation but note that a more sophisticated measure, the psi statistic, produces essentially the same results.

stimulate the development of a local supplier network until the increasing outward orientation in the late 1980s. Other factors are at work that relate to persistent low domestic content, even after the policy changes that started to stimulate local sourcing. These other factors include transnational corporate strategies that do not consider local procurement to be important, and U.S. import tariffs on Mexican intermediates embodied in maquila exports. Supply side constraints also affect the domestic content of exports. For example, local firms have to pass very strict and time-consuming processes of certification and quality control before they can provide multi-national firms with inputs, which appears in particular an obstacle to potential suppliers to electronics maquiladoras. In addition, the quality and technology of inputs demanded by maquiladoras is typically quite high and often subject to change. Maquiladoras demand low prices for their inputs, and they demand predictable delivery times.

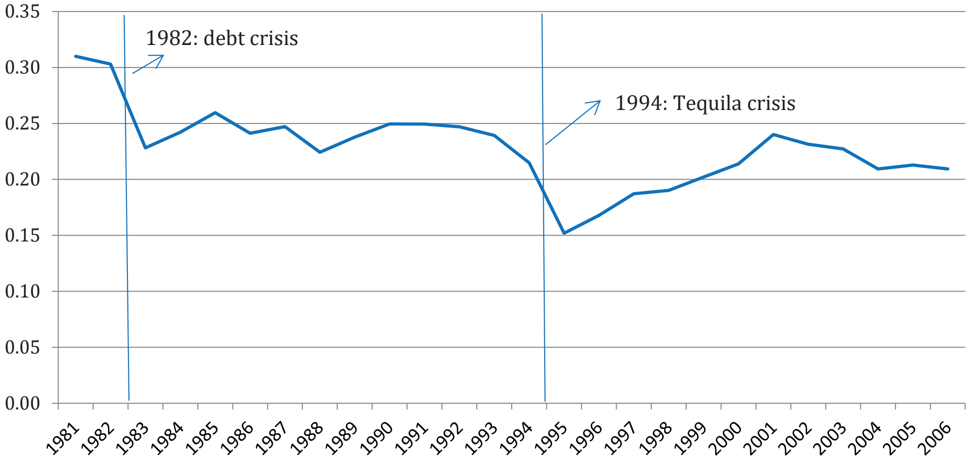
The domestic content varied substantially over time. In particular, the 1982 debt crisis and the 1994 Tequila crisis coincide with a substantial drop in domestic value added embodied in maquila output.[19] After the 1982 debt crisis there does not seem to be a recovery, but after the 1994 crisis the domestic content recovered to levels observed before the crisis. The increasing value added content during the second half of the 1990s is consistent with case study findings presented by Buitelaar and Perez (2000). Indeed, the abolition of U.S. duties on Mexican intermediate inputs with the 1994 NAFTA agreements might have had a positive effect on domestic sourcing by maquiladoras, although the 1985 GATT agreement appears unrelated to a substantial change in domestic value added. After 2001 we observe that the domestic content share decreases again. These results suggest that aggregate patterns appear mainly related to internal and external shocks, such as the 1982 and 1994 crisis, and not so much to changes in the regulatory environment.

In table 4.3 we further explore the domestic content of exports at the industry level. These results are obtained by replacing the export vector $\mathbf{e}^P$ in equation (4.1) by a diagonal matrix with the vector $\mathbf{e}^P$ on the main diagonal. The findings suggest that the domestic content differs substantially across sectors. In particular, the domestic content is low in electronics manufacturing (14 percent in 2006) as compared to textiles manufacturing (31 percent). The findings tend to suggest that the domestic content is lower in technology-intensive sectors.[20]

[19] These findings seem at odds with currency devaluation, which one would expect to result in a decrease of imported intermediates. However, other effects may dominate. For example, credit constraints or increased uncertainty may affect domestic sources, and changes in industry composition of exports may also affect these outcomes. If industries with lower domestic value added content expand, the overall effect is a decrease in domestic content of aggregate maquila exports, further discussed in section 4.5.2.

[20] de la Cruz et al. (2011, 2013) find similar differences across sectors.

Figure (4. 2): The Domestic Content of Aggregate Maquila Exports.



Notes: Domestic content as a share in aggregate maquila exports.
Source: Author's calculations using time series estimates and equation (4.1).

Table (4. 3): Domestic Content of Maquila Exports, Industry Results.

	1981	1990	2000	2006
Food, Beverages and Tobacco	0.27	0.64	0.62	0.44
Textiles and Textile Products	0.28	0.27	0.31	0.31
Leather, Leather and Footwear	0.44	0.38	0.27	0.28
Pulp, Paper, Printing and Publishing	0.56	0.28	0.36	0.31
Chemicals and Chemical Products	-	0.47	0.43	0.46
Rubber and Plastics	0.37	0.37	0.36	0.35
Other Non-Metallic Minerals	0.48	0.44	0.33	0.18
Basic Metals and Fabricated Metal	0.31	0.27	0.31	0.30
Machinery	0.37	0.26	0.25	0.26
Electronics	0.25	0.20	0.16	0.14
Transport Equipment	0.33	0.27	0.21	0.27
Miscellaneous manufacturing	0.35	0.28	0.24	0.25
Business services	0.91	0.52	0.42	0.41

Notes: author's calculations using time series estimates and equation (4.1) where $\mathbf{e}^{P}$ is put on the main diagonal of a matrix of equal dimension as the number of industries.

The time series results from 1981 to 2006 suggest that in some industries the domestic content was relatively stable, for example in textiles at about 30 percent. However, in most industries the share fell, even if we ignore the results for the early 1980s, although the decline then becomes less pronounced. For example, in the non-metallic minerals sector, the domestic content declined substantially from 48% in 1981 to 18% in 2006. This sector experienced a considerable change in its sourcing pattern, in particular after the implementation of NAFTA, which removed tariff imports of glass, gypsum, and cement. The domestic content of leather and footwear maquila manufacturing declined during the 1990s. It came after the opening up of the market in 1988, when tariffs on imports were cut and all import licenses were eliminated. Mexican shoe manufacturers were initially ill-equipped to compete with imports on price, quality and fashion content (Rabellotti, 1999). It also brought more pressures to domestic suppliers in the footwear industry since there were great difficulties in the supply of raw materials and particularly in the supply of bovine leather (Ortiz and Martinez, 2000). Thus, many producers substituted domestic supplies with cheaper and higher quality imported supplies (Woodruff, 1998).

The pulp, paper, printing and publishing sector experienced a gradual decline in domestic content after 2000. Here Mexican firms face stiff competition from forestry firms in Canada and the United States who leverage their technology and scale of production to supply forestry products of high quality and low price. The biggest change for machinery manufacturing appears to have happened in the 1980s. In its "Plan Nacional de Desarrollo Industrial: 1979-1982" the government started to promote the production of capital goods. The government was expected to purchase 40% from the total production of machinery and equipment. Furthermore, the domestic production of machinery and equipment was to be purchased by the government with a price 15% higher than the one established by the market. The government also offered to pay the transportation costs. Following the same stream of ideas, the government also offered fiscal credits (25% for new investments) and preferential prices for electricity, fuel oil, natural gas, and basic petrochemical goods (Bancomext, 1979). Nonetheless, the government decided to stop this whole program due to the debt crisis faced by Mexico in 1982. After that, imports of machinery products became increasingly important. In business services the domestic content also fell, especially during the 1990s from 52% in 1990 to 42% in 2000. The maquiladora business services sector mainly consists of the provision of specific services to maquiladoras such as renting of industrial units, transportation, customs tariff advice, legal advice, services for the hiring and provision of labor and they supply services aimed at facilitating maquiladora exports. A Maquiladora decree in 1989 (and a follow up in 1998) gave services firms much more freedom in importing equipment and other inputs free of duty (González-Aréchiga et al. 1991, which might be related to the drop in domestic content after 1990.

The food sector experienced an increase in domestic content during the 1980s and a decline after the 1990s. Initially, in the early 1980s, the food sector was characterized by a high level of foreign content. Most of the multinationals in the food industry were of US origin. These firms used abundant and cheap agricultural products from the US, such as wheat, soy, sorghum and milk, because they were highly subsidized by the US government. In contrast the multinational firms did not process much of Mexico's main food staples such as corn, beans, and rice (Rama, 1984). In order to increase the domestic content in the food industry, the Mexican government imposed several restrictions on agricultural imports when the GATT was signed (GATT, 1986). Amongst others, these import restrictions included a 45% tariff on imports of condensed milk, 50% on butter, 10% on sorghum, 40% on corn, wheat, soy, beer, wine (GATT, 1986). Our findings suggest that these restrictions are related to an increase in domestic content during the 1980s, suggesting a switch to more domestic inputs following the GATT provisions. However, in line with the implementation of NAFTA, the restrictions for the imports of sorghum were removed in 1994, those for wheat, milk and soy in 2003 and those for corn in 2008 (Schwentesius Rindermann and Gómez-Cruz, 2001). The maquiladora decree of 2002 also allowed tariff exemptions on the imports from milk (powder), eggs, corn (powder), and sugar. After 1990 we again observe a decline in the domestic content of the food industry.

For the largest maquiladora sector, 'maquiladora electrónica' or electronics maquiladoras, we also find a decline in the domestic content, from 25 percent in 1981 to 14 percent in 2006. During the 1980s, as electronic production expanded, more complex technologies were introduced such as microelectronic machinery (Brown and Dominguez, 1989). These technologies were intended to better control the productive process and reduce labor costs. Besides reducing on direct labor inputs, local suppliers also faced difficulties in expanding their supply of intermediates. For example, local suppliers experienced difficulties in obtaining quality certificates; had continuous changes in the design of electronic products; and faced formidable foreign competition. In 2001, a critical year for the electronic industry with the dot.com crisis in the US and the entry of China to the WTO, the Mexican government unilaterally implemented the 'Information Technology Agreement (ITA)' (Olliver-Fiero, 2007). The ITA eliminated tariffs on electronics imported into Mexico, including tariffs on subassemblies and raw materials used for electronics production. These policies helped to strengthen the position of maquiladora producers in the electronics industry, but they did not promote the production of subassemblies and components by Mexican firms. Most inputs provided by local suppliers are those used in the last stage of manufacturing production, such as corrugated fiberboard, accessories for metal casting, instruction manuals, wooden pallets, polyethylene, foam, uniforms, packaging and so forth (Carrillo and Zarate-Cornejo 2003).

4.5.2 The Domestic Content of Maquila Exports: a Disaggregation Analysis

To disaggregate the aggregate change in domestic export content, we apply a 'within' and 'between' analysis, which can be written in the current context as follows

$$DCE_{t+1} - DCE_t = \sum_i \left(\left((DCE_{i,t+1} - DCE_{i,t}) \left(\frac{\omega_{i,t+1} + \omega_{i,t}}{2} \right) \right) + \left((\omega_{i,t+1} - \omega_{i,t}) \left(\frac{DCE_{i,t+1} + DCE_{i,t}}{2} \right) \right) \right), \quad (4.2)$$

where $DCE_{i,t}$ is the domestic content of exports by industry *i* in year *t*, and $\omega_{i,t}$ is industry *i*'s share in total exports at time *t*. The industry contribution in equation (4.2) is split into two terms. The first term gives the industry contribution due to changes in the industry level DCE share (within), and the second term gives the contribution due to changes in the industry-level export share (between).

The results from this decomposition are given in table 4.4 for the period from 1981 to 2006. Contribution from the three most important maquila sectors (based on export shares) are shown, namely textiles and textile products, electronics, and transport equipment. The other sectors are grouped. The decomposition suggests that changes in the aggregate domestic content are mainly accounted for by changes within industries. The substantial drop in the domestic content of electronics manufacturing accounts for almost two thirds of the aggregate change in domestic content.

Table (4. 4): Sources of Change in Domestic Value Added of Maquila Exports, 1981 to 2006

	Share of domestic content in exports		Contribution of (in percent):		
	1981	2006	Change in industry DCE intensity	Change in industry share in overall exports	Total
Total maquiladora	**0.31**	**0.21**			
Textiles and Textile Products	0.28	0.31	-2.6	23.8	
Electronics	0.25	0.14	61.7	4.4	
Transport Equipment	0.33	0.27	8.0	-17.1	
Other			27.7	-6.0	
			94.8	5.2	100

Notes: author's calculations using equation (4.2).

The dominance of within-industry effects is confirmed from decompositions using different time periods. In table 4.5 we do the same decomposition, but for the period from 2001 to 2006. This period coincides with the demise of textile maquiladora activities due to the strong competition from China after its entry to the WTO in 2001 and the end of the Multi-Fibre Arrangements in 2004 (Utar, 2013). The effect of the shrinking share of textile manufacturing output (it fell from 13 percent in 2001 to 7 percent of gross output in 2006) is clearly borne out by the decomposition results. About half of the fall in the domestic content between 2001 and 2006 is accounted for by textile manufacturing. Interestingly, changes within industry still explain most of the change in the domestic content of exports. The 'within' explanation of changes in the aggregate content is the dominant explanation, also if we consider different time periods. Again, electronic manufacturing accounts for the majority of the within-industry decline in the domestic content of exports.

Table (4. 5): Sources of Change in Domestic Value Added of Maquila Exports, 2001 to 2006.

	Share of domestic content in exports		Contribution of (in percent):		
	2001	2006	Change in industry DCE intensity	Change in industry share in overall exports	Total
Total maquiladora	**0.24**	**0.21**			
Textiles and Textile Products	0.35	0.31	13.2	51.3	
Electronics	0.18	0.14	68.7	-8.2	
Transport Equipment	0.24	0.27	-18.9	-3.3	
Other			26.6	-29.4	
			89.6	10.4	100

Notes: author's calculations using equation (4.2).

4.6. Concluding Remarks.

This chapter studied the domestic content of maquila industries. It took a long-run macro perspective in order to relate changes in industrial policies to changes in the domestic content of maquila exports. Initially the government viewed maquiladoras as mere providers of jobs. This view and subsequent industrial policies shifted with the increasing outward orientation of Mexico in the late 1980s. We combined a recently released input-output table for maquiladora industries with detailed longitudinal data on output and inputs to study whether observed patterns are related to changes in industrial policy. We find substantial differences in the domestic value added content of exports across industries and over time. The domestic content is typically higher in labor-intensive goods manufacturers, such as textiles, compared to more capital-intensive industries such as transport and electronic goods manufacturing. Over time, productivity and the share of skilled workers in maquiladoras improved only modestly. A long-run decline in aggregate domestic value added embodied in maquila exports, from 31 percent in 1981 to 20 percent in 2006, is largely accounted for by the falling domestic content in electrical machinery product manufacturing. Overall, our findings suggest that even if industrial policies had their intended effects for specific sectors at specific moments in time, these effects are not observed in the aggregate as the domestic content fell.

This paper is the first to study long-term trends in the domestic content of Mexico's maquila exports. So far, most analysis of domestic content and technology upgrading within maquiladoras are limited to case studies. We provide a macro perspective to these case studies. A clear limitation in this approach is that we are unable to causally link industrial policy to the domestic content of exports. Typically, detailed micro studies are better able to isolate effects of particular policies. However, our findings show the overall picture, which suggests that even if some detailed micro studies may find that industry-specific policies have been successful (Jordaan, 2011), overall these policies are not visible as productivity levels and the use of skilled workers in maquila industries hardly improved. Also, we do not find a systematic tendency of increased domestic sourcing of inputs.

This carries important implications for other developing countries that try to start a process of technological upgrading after entering global value chains via final assembly activities.

Various policy measures might be considered to increase the local content of maquiladoras production. We discuss some here, but refer the interested reader to Brannon et al. (1994) and Verhoogen (2012) for further discussion. In particular, the government might seek to strengthen engineering and design capacities by means of active education and technology acquisition policies. Typically these high-skilled activities generate much higher value added compared to the provision of standard inputs such as boxes and packaging materials. Also, the Mexican government might stimulate decentralized decision making at maquiladora establishments and engaging them with local suppliers. If maquiladoras source inputs locally, they have a strong incentive to improve the quality of these goods sourced, which stimulates productivity growth of suppliers (Brannon et al., 1994). Also, government officials might actively encourage joint ventures to increase technology spillovers. Although our analysis is for Mexico’s maquiladoras, we belief the analysis presented here has wider appeal. In particular the analysis has wider relevance for other developing countries that are characterized by low domestic value added content of exports as our analysis seeks to relate industrial policies to changes in the domestic content of exports. Many other Central-American countries, but also developing Asian and African countries have export processing firms and low domestic content (Koopman et al. 2014). Which nations and firms have been successful and why? Future research may seek to extent this type of long-term analysis of industrial upgrading to other developing countries to get a tighter grip on policies that kick start technological upgrading.

Chapter 5.

Mexican Manufacturing and its Integration into Global Value Chains †,**

Abstract

This paper studies the value added contributions to final manufacturing output produced in Mexico. It distinguishes between contributions originating from foreign producers located in different major regions of the world economy and contributions made by domestic producers. The analysis is performed for the main two components of Mexican manufacturing: assembly plants producing for export markets (Maquiladora industry) and manufacturing firms mainly producing for the domestic market (Domestic Manufacturing). To this end, Mexico (Maquiladora) and Mexico (Domestic Manufacturing) are separately included into World Input-output Tables (WIOT) from 1998 to 2011. The empirical analysis shows that the structure of value added contributions with regard to the final output of the Mexican domestic sector has remained unaltered, while the structure of value added contributions to the final output of the Maquiladora sector has drastically changed over time.

For its own final output, Mexico (Domestic) has the largest share of value added contributions with some increase in the value added contributions of producers in foreign countries (notably, the USA). With regard to the final output of Mexico (Maquiladora) there was a shift from a dominance of US value added in all the manufacturing sectors (70% in 1998) to a much more diversified structure of value added contributions. By 2011, the East Asian share in value added was the largest in the Electrical and Optical equipment sector. Mexico (Domestic Manufacturing) and Mexico (Maquiladora) had the largest value added contributions in the Transport Equipment sector, while the US continued to account for the lion's share of value added in the textile industry.

In my view, those changes in the structure of value added contributions have to do with decisions by US firms to reallocate production to low-cost countries in Asia. They reflect changing patterns of the integration of Mexico in global value chains.

JEL Codes: C67, L6. F2

Keywords: Global Value Chains, Export processing, World Input-output Tables, Manufacturing, Mexico

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5.1 Introduction

In the last two decades, Mexico's manufacturing production has increased substantially. According to De La Cruz et al. (2011), Mexico's international trade (exports plus imports of goods) grew from $82.3 billion in 1990 to $553.8 billion in 2007, representing 56% of the GDP during that same year. Moreover, this remarkable performance is further confirmed by the current position of Mexican manufacturing. According to the Mexican Ministry of Economic Affairs, by 2014 Mexico was producing more manufacturing goods than all other Latin American countries put together; it is the World's largest provider of flat screen televisions and the largest recipient of FDI in the Aerospace sector (Secretaría de Economía, 2016).

Assessing the domestic and foreign value added content of Mexican manufacturing production has been a major concern of scholars. However, they have reached very different conclusions depending on the different components of Mexican industry that they studied. For instance, when considering the production from the whole universe of manufacturing firms in Mexico, the conclusion has been that domestic value added content is substantially higher than the foreign one. According to the Trade in Value Added initiative (OECD-WTO, 2015) Mexico's domestic value added content of its exports in 2011 was 70% and had remained relatively stable since the 2000's. A similar conclusion is reached when the manufacturing firms that produce both for the domestic and for the foreign market (i.e. the Domestic economy of Mexico) are analyzed. According to the estimates of De La Cruz et al. (2011) and Koopman et al. (2014), the domestic share of value added content in the exports of Mexico-Domestic is more than 70% in 2004. On the other hand, when analyzing the firms that solely produce for the foreign market (Maquiladora industry) very different conclusions are reached. In this case, it is found that the firms in the Maquiladora sector have been unable to steadily increase the domestic value added content of their exports (less than 25% of total value added content) (De La Cruz et al., 2011; Koopman et al.,2014; Castillo and De Vries, 2018).

This research studies the value added trends observed in the final output produced by Maquiladora and by the Domestic economy of Mexico in a single unified framework. It is the Global Value Chain perspective that provides such a unified framework. This means that we will quantify the value added contributions from domestic and foreign producers (by country of origin) that participate in the production for exports (Maquiladora), as well as the value added contribution in the production that supplies both domestic and foreign markets (Domestic Economy of Mexico). We examine two main research questions:

(1) Which regions and countries capture most of the value added embodied in Mexico's final output as a result of the increasing globalization of production?;

(2) To what extent does Mexico itself benefit from such final output?.

With regard to the first research question, our aim is to understand to what extent foreign producers in major regions (US/Canada, East Asia and Europe) interact with each component from the Mexican manufacturing production (Domestic Economy and

Maquiladora), as well as the extent to which such regional interaction within each manufacturing component drives the foreign value added content for the total manufacturing production in Mexico. With regard to the second research question we want to analyze how local producers in the Maquiladora and in the Domestic Economy of Mexico interact in order to produce their own manufacturing goods and the extent to which their own value added content drives the results for the total domestic value added content in the total manufacturing production of Mexico.

In order to meet those objectives, we have constructed a novel data set where the Maquiladora and the Domestic Economy of Mexico are included into the World Input-output Tables (WIOT) from 1998 to 2011. With help of such tables, and by implementing a new measure of fragmentation that is extended to a multi-country setting (Los et al., 2013), our research will show that each component of Mexican manufacturing production has had a different pattern of integration into Global Value Chains.

On the one hand, the value chains of manufacturing production in the Domestic Economy of Mexico are still predominantly local and regional. Such production only experienced minor changes in terms of the local/ regional value added content embodied on its final output. Between 1998 and 2011, local producers in the Domestic economy of Mexico accounted for the largest value added share (74% of the value added content of total final output in 2011), while there were only minor increases in the share of firms from US/Canada and East Asia in the value added content of final output (16% and 3% respectively by 2011). This pattern where local producers in the Domestic Economy of Mexico have the largest share in the value added content embodied on its own final manufacturing output was observed in every single manufacturing sector with very few changes over time.

On the other hand, value chains in the Maquiladora sector are both regional and global. Over time, Maquiladora presents major changes on its country/ regional value added content. The US/Canada share in value added content embodied in the total maquiladora final output dramatically decreased from 68% in 1998 to 29% in 2011. During the same period, the corresponding East Asian and Mexican value added in final maquiladora output increased from 6% to 23% and from 20% to 33%, respectively. This trend, however, shows substantial variation across key maquiladora manufacturing sectors. While US/Canada had the largest share of value added content in every single manufacturing sector in 1998, by 2011 East Asia had the largest share in Electronic Equipment (40%), and local Mexican producers had the largest share in Transport Equipment (49%) and US/Canada in Textiles and Textile products (39%).

Thus, on the basis of the empirical evidence, our research reaches four major conclusions.

First of all, we identify a decline in the dependence of Maquiladora production on US inputs. This decline is counterbalanced by an increasing use of East Asian inputs (mostly sourced from China).

Second, we provide new empirical evidence for the debate between regionalization and globalization of the sourcing of inputs for manufacturing production.[21] Much current research argues that global value chains in manufacturing is still primarily operate at the local and regional level despite dramatic decreases in transport and communication costs. Our research, on the other hand, indicates that countries with maquiladora-like production (export processing zones) can experience both regionalization and globalization of manufacturing production[22]. The relative importance of localization, regionalization or globalization of manufacturing will depend on certain conditions related to the type of final good being produced (its modularity), trade and policy incentives, the competitive advantages offered by the country and so forth.

The third finding is the complex scenario that policy makers face nowadays, if they wish to increase the use of domestic inputs in the context of global value chains. Our results for the automotive industry in maquiladora production indicate that incentives provided under industrial policies and trade agreements (such as NAFTA) are not sufficient to increase the use of domestic inputs. Maquiladora production in this particular manufacturing sector further required bilateral industrial cooperation between the governments of Mexico and the United States. This bilateral cooperation, effectively combined with Mexican tax incentives and NAFTA benefits, seems to have been the key factor behind the increasing domestic value added content in the transport sector.

The last finding from our research is the relative contribution of domestic inputs in creating value added in the domestic sector and in the Maquiladora. Our research indicates that over time the domestic sector has had much stronger domestic linkages than Maquiladora. Moreover, we show that the aggregate trends in domestic value added content for the whole universe of producers in Mexico is largely driven by the producers in the Domestic economy of Mexico. Therefore, the role of maquiladora production in inducing a higher use of domestic inputs remains limited.

This chapter is structured as follows. Section 5.2 describes the main characteristics in the production of Maquiladora and in the Domestic Economy of Mexico, as well as some considerations about the key features of manufacturing production in Mexico. Moreover, this section describes the new concept of “Manufactura Global”. This concept, introduced by the Mexican statistical office, represents the new official statistical tool to study maquiladora-like production within the national accounting system from Mexico. Section 5.3 describes our methods. Section 5.4 presents our data construction strategy to divide Mexico (as presented by WIOD) into Mexico (Maquiladora/Manufactura Global) and Mexico (Domestic Economy) from 1998 to 2011. Section 5.5 presents our data requirements. Section 5.6 introduces information with regard to sectoral gross output shares and sources of intermediate inputs (by country and region of origin). Section 5.7 presents our main empirical results. Finally, section 5.8 provides conclusions and some ideas about the future of manufacturing in Mexico.

[21] Regionalization refers to the sourcing of inputs from Mexico's NAFTA neighbors Canada and the USA. Globalization refers to the sourcing of inputs from Asia. Local value chains refer to the sourcing of inputs within the domestic economy of Mexico.

[22] Globalization of manufacturing production should be understood as the increasing participation of countries outside the region in the final output produced by a given country.

5.2 An Overview of Mexican Manufacturing

The firms in the Mexican manufacturing industry can be classified into two categories. On the one hand, there are the manufacturing firms that participate in Mexico's export promoting program. Here, we observe firms that participate in the maquiladora program (that export their entire production to foreign markets) and, as of 2007, firms that participate in the IMMEX program (which include maquiladora plants and, a broader set of firms that produce both for domestic and foreign markets. The second category are all those firms that do not participate in the previously mentioned export promoting programs and that also produced for domestic and foreign markets (i.e. the domestic manufacturing of Mexico). In the forthcoming paragraphs, we discuss each of these categories in more detail.

5.2.1. Export Promoting Programs and the Production for Global Production Networks.

The Maquila industry, officially known as "Industria Maquiladora de Exportación", mainly consists of foreign firms located in the North of Mexico close to the border with the United States. The Maquiladora export promoting program allows for the temporary imports of intermediate imports (and of capital goods) for the production of manufacturing goods in Mexico. Provided that such production is exported, Maquiladora firms receive significant tariff incentives. Those tariff incentives include exemptions from general import taxes, value added taxes and countervailing duties, when applicable. Most of the intermediate inputs used by the Maquila industry come from the United States (though progressively more from East Asia), and its entire final output is exported, mainly to the United States.

According to official statistics, Maquiladora firms do not produce any intermediate goods. The domestic intermediate goods used by the Maquiladora are completely sourced by local manufacturing producers in the rest of the economy (i.e. local producers in the Domestic Economy of Mexico). Historically, and as described in chapter 2, the Mexican government has made some attempts to promote increasing domestic sourcing of intermediate inputs from local producers by Maquiladora firms. These attempts include programs for the development of domestic suppliers, support for research and development activities (Durán, 2005) and, more recently, the establishment of meetings between maquiladora producers and domestic suppliers in order to negotiate input sales. Nevertheless, as documented in chapter 4 of this dissertation, the Maquiladora industry has not increased its domestic intermediate consumption over time. Furthermore, chapter 4 documented a long-run decline in the domestic value added content of maquiladora exports (from 30% in 1981 to 20% in 2006), which appears mainly related to external and internal shocks to the Mexican economy (debt crisis, signing of NAFTA , industrial emergence of China) rather than changes in the regulatory environment.

The maquiladora firms do not have much incentive to increase domestic sourcing of intermediate inputs. The reasons for this, however, are not limited to the tariff exemptions provided on the imports of intermediate goods. Other reasons include the high standards imposed by Maquiladora firms on domestic producers. For example, domestic producers have to meet very strict and time-consuming processes of certification and quality control before they can supply inputs to multi-national firms in the Maquiladora sector. In addition, the quality and technology of inputs demanded by maquiladoras is typically quite high and often subject to change.

Given the success of the Maquiladora program in increasing the size and export orientation of Mexican manufacturing[23], the Mexican government has implemented similar other export promoting programs. As discussed in chapter 2, by 1985, the "Programas de Importación Temporal para Producir Articulos de Exportación" (PITEX) came into effect with the intention of permitting firms to import intermediate inputs and machinery free of duty as long as 30% of their total sales were exported. The difference between the PITEX and the maquiladora program lies in the fact that under the latter program firms were exempted from taxes to an even higher degree. Similarly, unlike maquiladoras, PITEX firms were mainly located in the interior of Mexico, as most of their production was destined for domestic consumption (De la Cruz et al., 2011).

In 2007, the "Manufacturing, Maquila and Export Service Industry" (IMMEX) program was implemented. This program combined Maquiladora and PITEX firms into a single export promoting program. Acknowledging new ways to organize manufacturing production, the IMMEX framework also allowed for the creation of new types of export promoting firms that were different to the concept of Maquiladora and PITEX firms (IMMEX Controladora and IMMEX Terciarizacion according to chapter 2). The main idea behind the IMMEX program was to integrate in a single framework all the manufacturing firms in Mexico that together represent 85% of the country's final manufacturing exports[24] (Secretaría de Economía, 2010). Likewise, this program aimed at simplifying tariff procedures for Maquila and PITEX firms that were to be exempted from the payment of general import tax, value added tax and, where appropriate, countervailing duties.

Acknowledging the increasing opportunities for participation of manufacturing firms in global value chains, in 2014 the Mexican Statistical Office (INEGI) released a new statistical tool named "Manufactura Global". This new statistical was designed to coexist with the information provided for the IMMEX program and with the old data for Maquiladora firms. The main objective behind the concept of Manufactura Global was to more thoroughly measure the participation of Mexican manufacturing firms in global production networks. To that end, INEGI identifies from the whole universe of manufacturing firms located in Mexico those that were highly engaged in global production networks. Conceptually, those Mexican firms highly engaged in global production networks are the ones that meet one of the following three criteria: (1) their production should be for exports and most of their intermediate goods should be

[23] The Maquiladora Program was initially set up during the 1960s as an emergency program to cope with rising unemployment in North Mexico. It only started to boom during the late 1980s with the increasing outward orientation of the Mexican economy.

[24] According to chapter 2 of this dissertation, in order to receive benefits from the IMMEX program, manufacturing firms are required to report annual sales of more than US$500,000 dollars or to export at least 10% of their total final output. Therefore, the remaining 15% of Mexico's total manufacturing exports might include firms that do not meet this sales criterion, that are not registered as IMMEX firms and that solely benefit from other incentives (trade benefits under NAFTA, competitive advantages from Mexico, etc.).

imported (a ratio of at least 2/3 of their imported intermediate goods with respect to their exports); (2) they should be mostly foreign owned or, (3) produce intermediate goods that are exported for the production of other global production networks not located in Mexico. If a manufacturing firm meets one these criteria, it is classified then as Manufactura Global. As can be seen, this concept takes into account both firms that import a significant amount of intermediate inputs, to re-export them back as final goods, as well as firms that export domestically produced intermediate goods for other manufacturing firms not located in Mexico.

By definition, firms under the concept of Manufactura Global include IMMEX firms (maquiladora and PITEX), as well as manufacturing firms not belonging to IMMEX but located in the domestic economy of Mexico and that meet the aforementioned criteria of being highly engaged in global production networks. According to the first estimates provided by INEGI (2014), the gross production from Manufactura Global represented 25.8% of the total manufacturing production in Mexico by 2012. This means that ¼ of the total production in Mexico participates in global production networks by either assembling/transforming domestic and foreign intermediate inputs and/or exporting final and intermediate goods.

5.2.2. The Domestic Economy of Mexico

As can be seen, the rest of manufacturing firms in Mexico that do not belong to the IMMEX program or that are not highly engaged in global production networks can be regarded as firms under the domestic economy of Mexico. The manufacturing firms under the Domestic economy of Mexico produce both for the foreign and the domestic market but most of their production is oriented to the Mexican market. According to the latest estimates, by 2012 the Domestic Economy of Mexico accounted for 74% of the total manufacturing production in Mexico and for 29% of the total manufacturing exports. In the same year, producers in the domestic economy accounted for 90% of total domestic intermediate goods in Mexico and 45% of the total supply of imported intermediate inputs (INEGI, 2014)

Data for the manufacturing firms under the domestic economy can be found in the monthly industrial survey (Encuesta Industrial Mensual) from INEGI and, as of 2014, they can be also found under the concept of "Rest of Manufacturing Production" in Mexico or "Manufactura No Global" (INEGI, 2014).

5.2.3 Competitive Advantages of Manufacturing Production in Mexico.

Manufacturing production in Mexico enjoys some significant advantages compared to other major emerging economies. Manufacturing producers in Mexico have benefited substantially from the proximity to the United States, from the tariff exemptions under NAFTA and from the existence of different export promoting programs (Maquiladora, PITEX and, currently, the IMMEX program). Nevertheless, some new features of the Mexican economy are expected to further boost manufacturing production. On the one hand, Mexico provides new opportunities for manufacturing producers given China's recently soaring wages. According to the Economist (2014), Mexican wages have grown less than 50% in dollar terms over a decade, leaving them 13% cheaper (adjusted for productivity) than China's. On the other hand, there is Mexico's new energy reform. The country's opening up to foreign investors in the oil industry, along with the discovery of new gas resources, is expected to boost production in the petro-chemical sector and, more importantly, to provide cheaper domestic energy. In this context, lower energy and labor costs will be the new advantages offered by Mexico that are complemented with its huge domestic market (120 million people by 2013) and its 44 free trade agreements.

Similarly, Mexico has a competitive advantage in four areas that allow the country to compete effectively with low-cost producers in East Asia. According to Watkins (2007), Mexico has competitive advantages in the following four lines of production; (1) manufacturing production with a high weight to value ratio (the production of cars, flat screens and appliances of large size); (2) production of firms that implement just-in-time procedures and whose production is subject to frequent changes in design (auto parts); (3) goods that require strong managerial involvement in order to meet high quality standards (aerospace industry and medical instruments) and; (4) manufacturing goods where the protection of property rights is important.

Products with a high weight to value ratio are those bulky manufacturing goods for which shipping represents a sizeable share of the cost structure. They include vehicles, non-collapsible furniture, electrical machinery, and appliances of large size. The lower costs of shipping these products from Mexico to the United States implies a benefit for firms that is sufficient to compensate for the large labor cost advantages offered by East Asian countries. Let us consider the case of a refrigerator proposed by The Boston Consulting Group (2008). According to their calculations, the typical U.S. retail price of this product is around $500 dollars. If it were manufactured in a low-cost East Asian country and sold in the United States the cost of shipping would represent $100 dollars (20% of the price tag), while producing it and shipping from Mexico would cost around $49 dollars (10% of the price tag). In this context, difference in freight costs is a major source of competitive advantage for Mexico[25].

Manufacturing firms that need minimize response times, tend to favor Mexico as a production site when they seek to produce for the North American market. Firms located in Mexico are able to offer just-in-time shipping to their counterparts in the US, with a distance short enough to make production in East Asia impractical. Door-to-door time for products sourced from China's east coast and continuing into the interior of the United States average three to four weeks via the West Coast of the United States and four to six weeks via the East Coast. In contrast, door-to-door time is less than a week for products sourced from Mexico (Boston Consulting Group, 2008). This advantage in delivery is critical for manufacturing products for which demand is volatile or for perishable, bulky and seasonal products for which carrying costs are high[26].

[25] In order to further understand the magnitude of the differences in shipping costs, the Boston Consulting Group (2008) also compares freight costs for shipping containers to Pittsburgh, from Mexico, Brazil and China. From Mexico, the shipping cost would be $2,679; from São Paulo, $4,637 and from Shanghai, $5,437.

[26] The shipping times in Mexico have been further reduced. In the past, trucks from Mexico were not permitted to cross the US border, so all shipments were unloaded and reloaded onto U.S. trucks (a process that delayed shipments for about eight hours). Nonetheless, as of September 2007, Mexican carriers have

Strong managerial involvement is required in the production of those goods that need to meet strict quality requirements. This is the case of the aerospace industry, the production of which also places a high premium on property rights. Both in terms of strong managerial involvement and protection of property rights, Mexico has a significant competitive advantage compared to East Asia. On the one hand, face-to-face meetings are more feasible given that Mexico does not have important time zone differences with major cities in the United States, as well the fact that flights between the two countries only take a few hours. Similarly, managerial involvement is enhanced by the fact that Mexico provides a sizeable pool of US-educated managers with Western ways of thinking and doing business (Boston Consulting Group, 2008). Next, as regards protection of property rights Mexico has advantages over most low country locations. This country has signed an important number of agreements with major advanced and emerging economies on reciprocal promotion and protection of investments (RIPPA)[27]. Such agreements are established by the Mexican Government to provide national and foreign investors with a legal framework that offers stronger protection for foreign investment and Mexican investment abroad.

We can mention some other competitive advantages of manufacturing production in Mexico. The production of components in Mexico's aerospace industry has received significant incentives in the last years. For instance, in 2007 Mexico and the United States signed the Bilateral Aviation Safety Agreement (BASA). This agreement recognizes the technical capabilities of Mexico's Directorate of Civil Aeronautics to certify the safety of components made in the country. The recognition provided by this agreement makes re-certification by the US Federal Administration unnecessary. This situation is extremely important for the aeronautic industry in Mexico. The agreement eliminates a step in the supply-chain since products no longer need to be examined internationally before being shipped off to consumers to undergo further assembly operations.

Mexican producers also enjoy the benefits provided by NAFTA. For instance, in the textile industry NAFTA rules are particularly demanding for non-NAFTA producers. This is the case of the NAFTA rules of origin "yarn forward" and "fiber forward". Yarn forward means that the yarn used to produce a fabric must originate in a NAFTA member country. Exemptions from those rules are granted in the cases where the imported textile yarns are not widely produced in North America (the case of silk), provided that the fabric is cut and sewn in one or more NAFTA countries. More demanding rules of origin obtain for textile goods which are widely produced in NAFTA. For example, cotton yarn and cotton knitted fabrics are subject to a fiber forward rule for goods traded between the three countries, while man-made fiber sweaters are subject to a "fiber-forward" rule as to trade between the United States and Mexico.

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been granted "hosted carrier" status, which allows them free movement within the United States, thus reducing shipping times (Boston Consulting Group, 2008).

[27] In general, those RIPPAs cover disciplines such as investment definition, scope of application, promotion and admission, investment treatment, expropriation, transfers and resolution of investor-State and State-State controversies.

NAFTA rules of origin in the automotive industry are also an important factor encouraging foreign investors to allocate their production to Mexico, rather than to East Asia. The North American regional value content requirement for autos and light vehicles, their engines and transmissions as well as for other vehicles was initially set at 50%. As of 2002 it was increased to 62%. As for production of televisions, under NAFTA regulations, flat screens assembled in Mexico enjoy duty free access to the US market even if they contain components originating from non-NAFTA countries.

Finally, it is also worth mentioning some other areas of production where Mexico has less competitive advantages. This is the case with manufacturing goods with light weight and high volume and the ones with a high value-to-weight ratios. The manufacturing goods with light weight and high volume include the textile industry in general as well as "other manufacturing goods" (umbrellas, toothbrushes, toys, bikes collapsible furniture and so forth). The goods with a high value to weight ratio are the ones produced by the electronic industry. Compared to Mexico, Chinese producers in those industries benefit from a well-developed chain of suppliers, abundant labor and a larger domestic market. Furthermore, the fact that the textile industry, other manufacturing goods and the electronic industry are not subject to frequent changes in style allows producers to plan the production well in advance. This characteristic, along with its light output weight, permits shipping the production further lowering transport and total costs. Similarly, many of those goods are mainly sold in North America by huge retailers such as Wal-Mart and its counterpart for the Mexican domestic market Wal-Mexico. Therefore, Mexican producers in those sectors will continuously face difficulties in increasing their market share in the US.

In a nutshell, the next decade will offer many significant advantages to manufacturing producers in Mexico compared to major producers in other emerging economies. Along with the proximity to the United States and tariff incentives under NAFTA and IMMEX rules, producers in Mexico will also benefit from lower labor and energy costs. Nevertheless, success in manufacturing will be greater if production is concentrated in activities where Mexico has the greatest competitive (or comparative) advantages. Manufacturing goods with a high weight to value ratio, whose quality is more important than their prices, that are specially protected under NAFTA rules and whose production is mainly oriented towards foreign markets will continue to be the key drivers of Mexican manufacturing production. These goods include flat screens, appliances of large size (fridges, electric ovens and so forth), medical instruments and automotive products. Following the same reasoning, the manufacturing goods that imply low weight and high volume but whose production is abundant in North America (and that are therefore protected under NAFTA considerations) will also be among the key drivers of Mexican manufacturing production. In this case, we are referring to the manufacture in cotton.

Manufacturing producers will face significant difficulties in increasing their production for exports in the manufacturing sectors where Mexico has less competitive advantages and, where production is less protected under NAFTA regulations. This will be the case for many textile products (clothing, footwear, leather, sportswear, etc.), electronic products (appliances of small size, mobile phones, computers, microwaves, and so forth) and other manufacturing goods.

5.3 Methodology

In assessing the value added contributions from the different countries and regions involved in the production of Mexico's final manufacturing output, our research will closely follow the approach proposed by Los et al. (2015). By generalizing a measure of fragmentation proposed by Feenstra and Hanson (1999), these authors introduce a metric that uses information from World Input-output Tables to describe the international fragmentation of specific global production networks. Specifically, Los et al. (2015) decompose the value of a final product in the last stage (country) where the final manufacturing production took place. This decomposition includes the value added generated in all the countries that contribute to that final product. Therefore, this measure does not only take into account the value added by the immediate suppliers of intermediates, but also the value added by suppliers further upstream

Formally, consider a particular industry *i* located in a specific country *j*, denoted by (*i,j*). For a good to be produced in an industry (i,j) activities in industries s=1,…,S in each of the countries n=1,…,N are needed. To decompose the total final value of this good into the value added contributions from different industries and countries, the first step to take is to find the levels of gross output associated with the production of (i,j). Those can be estimated by applying standard input-output methods to global input-output tables. Global input-output tables contain information on the values of intermediate input flows among all country industries in the world, as well as on the values of flows from each of these country-industries to final use in each of the countries.

These tables also contain information on value added generated in each of the country industries. Combining information on value of sales and value added per dollar of sales leads to estimates of value added in each of the *S*N* industries as a consequence of final demand for product (i,j). For this, we use an equation that has been a standard tool in input-output analysis for over decades (Miller and Blair, 2009);

$$\mathbf{g} = \hat{\mathbf{v}}(\mathbf{I}-\mathbf{A})^{-\mathbf{1}}(\mathbf{Fe}) \quad (5.1)$$

In this equation[28], $\mathbf{g}$ is the vector of value added created in each of the SN country-industries involved in a value chain. The choice for a specific final output matrix **F** determines which value chain is considered. Final output is output delivered for household consumption and investment demand (both including domestic and final foreign demand). $\mathbf{e}$ is a summation vector. $(\mathbf{I}-\mathbf{A})^{-\mathbf{1}}$ is the well-known Leontief inverse, the use of which ensures that value added contributions in all tiers of suppliers are taken into account. $\mathbf{v}$ is a vector with value added to gross output ratios, for each of the country-industries[29]

The (*SNxSN*)-matrix $\mathbf{A}$ and the (SN)-vector $\mathbf{v}$ are obtained as $\mathbf{A} = \mathbf{Z}(\hat{\mathbf{x}})^{-\mathbf{1}}$ and $\mathbf{v}' = \mathbf{w}'(\hat{\mathbf{x}})^{-\mathbf{1}}$, respectively. $\mathbf{A}$ gives the intermediate inputs per unit of output of gross output (x), while $\mathbf{v}$ represents the value added generated per unit of gross output. F stand for a final demand matrix of dimensions SNxCN (where C is the number of final

[28] This equation has been already introduced in Chapter (3) as equation (3.1).

[29] Matrices are indicated by bold capital symbols and (column) vectors by bold lowercases. Hats denote diagonal matrices with the corresponding vector on the main diagonal.

demand categories per country). This implies that **Fe** is an (SN) vector with a single positive element, which is obtained by adding foreign and final demand for (I,j)'s product.

As can be observed, implementing the aforementioned methodology will allow us to decompose **g** which contains the value added generated in each of the industries in each of the countries that can be attributed to the global value chains of final manufacturing production in the domestic economy of Mexico (Domestic) and the Mexican Maquiladora sector (Maquiladora/Manufactura Global). Implementing this methodology in our research requires World Input-Output Tables that include separate input-output tables for Mexico (Domestic) and Mexico (Maquiladora/Manufactura Global).

5.4 Data Construction Methods: How to Include Mexico (Domestic) and Mexico (Maquiladora/Manufactura Global) in WIOT?

A World Input-Output Table (WIOT) is an extension of a national input-output table. A WIOT explicitly indicates the imports by country of origin of goods for intermediate and final use, received by countries. In this paper, the analysis is based on the World Input-Output Database (WIOD) of the Groningen Growth and Development Centre (GGDC, 2015). A WIOT also indicates the domestic consumption of goods for intermediate and final use and the delivery of those goods domestically produced by county of destination. The novelty of the present paper is that we break down the input-output data for Mexican manufacturing into a maquila sector and a Domestic sector. Referring to our discussion in section 5.2, figure 5.1 indicates the set-up for a WIOT that divides Mexican Manufacturing into its Domestic economy and Maquiladora/Manufactura Global components. This figure has been divided into three sets. Set (A) indicates the industry by industry intermediate use of goods from WIOD countries according to their origin (imported or domestic). Set (B) indicates the final use of goods from WIOD countries according to their origin. Finally, set (C) indicates the total output in each WIOD country.

As can be seen in set (A), Mexico (Domestic) and Mexico (Maquiladora/Manufactura Global) report their industry by industry intermediate use of goods delivered by Country A and the rest of the World respectively (imported intermediate goods). At the same time, Mexico (Domestic) and Mexico (Maquiladora/M. Global) report their industry by industry intermediate use of goods that are both delivered by the Mexico (Domestic) (domestic intermediate goods). Similarly, given that the maquiladora does not deliver any intermediate goods to country (A), Mexico (Domestic), Mexico (Maquiladora/M. Global) and the rest of the world all the squares designed to indicate those deliveries are left in blank (they are equal to zero).

On the other hand, in set (B), Mexico (Domestic) and Mexico (Maquiladora/M. Global) report their final use consumption according to domestic or imported origin. Mexico (Domestic) indicates the final use of goods delivered by Country (A,) by Mexico (Domestic) and by the rest of the World. Following our definition of maquiladora, Mexico (Maquiladora/M. Global) only indicates the final use of capital goods delivered by Country (A) and by the rest of the World. Country (A) in set B reports the final use of goods delivered by Country (A), by Mexico (Domestic), by Mexico (Maquiladora/M. Global) and by the rest of the World. The same description for Country (A) applies for the rest of the world. Finally, set (C) indicates the total output by each industry in each WIOD country.

Figure (5. 1): WIOT Set up with Mexico (Domestic) and Mexico (Maquiladora)

		A				B				C
		Country A Intermediate use Industry	**Mexico (Domestic)** **Intermediate use** **Industry**	**Mexico (Maq/M.Global)** **Intermediate use** **Industry**	Rest of the World Interm. use Industry	Country A Final domestic Use	**Mexico (Dom.)** **Final domestic Use**	**Mexico (Maq/M.G)** **Final domestic Use**	Rest of the World Final domestic Use	Total
Country A	Industry	Intermediate use of domestic output	Intermediate use by Mexico (Domestic) of imported inputs delivered by country A	Intermediate use by Mexico (Maq/M.Global) of imported inputs delivered by country A	Intermediate use by RoW of imported inputs delivered by country A	Final use of domestic output	Final use by Mexico (Domestic) of imported final goods delivered by A	Final use by Mexico (Maq/M.G.) of imported final goods (Gross Capital Formation) delivered by A	Final use by RoW of imported final goods delivered by A	Output in A
Mexico (Domestic)	Industry	Intermediate use by A of imported inputs delivered by the Domestic economy of Mexico	Intermediate use by Mexico (Domestic) of intermediate goods delivered by Mexico (Domestic)	Intermediate use by Mexico (Maq/M.Global) of intermediate goods delivered by Mexico (Domestic)	Intermediate use by RoW of imported inputs delivered by country Mexico (Domestic)	Final use by A of imported final goods delivered by Mexico (Domestic)	Final use of domestic output delivered by Mexico (Domestic)		Final use by RoW of imported final goods delivered by Mexico (Domestic)	Output in Mexico (Domestic)
Mexico (Maq/M.G.)	Industry					Final use by A of imported final goods delivered by Mexico (Maq/M.G)			Final use by RoW of imported final goods delivered by Mexico (Maq/M.G)	Output in Mexico (Maq/M.G.)
Rest of the World (RoW)	Industry	Intermediate use by A of imported inputs delivered by RoW	Intermediate use by Mexico (Domestic) of imported inputs delivered by RoW	Intermediate use by Mexico (Maq/M.Global) of imported inputs delivered by RoW	Intermediate use of domestic output	Final use by A of imported final goods delivered by RoW	Final use by Mexico (Domestic) of imported final goods delivered by RoW	Final use by Mexico (Maq/M.G) of imported final goods (Gross Capital Formation) delivered by RoW	Final use of domestic ouput	Output in RoW
		Value Added	Value Added	Value Added	Value Added					
		Output in A	Output in Mexico (Domestic)	Output in Mexico (Maq/M.Global)	Output in RoW					

In order to implement these ideas, several adaptations have to be made to the input tables (supply and use tables) originally used by WIOD that allow us to include Mexico (Domestic) and Mexico (Maquiladora/M. Global) into the structure of the World Input-Output Tables. So as to better understand how our research needs to proceed, the left hand side of Figure 5.2 presents an overview of the supply and use tables used by WIOD to include Mexico (Total Economy) in the World Input-Output Tables As can be seen, WIOD first created national (i.e. total economy) supply and use tables which were then used to create national input-output tables. Afterwards, those supply and use tables were linked across countries (by means of bilateral trade data) to create international supply and use tables for Mexico. Finally, the international supply and use tables of

Mexico, and that of the rest of WIOD countries, were used to create the world input-output tables. Considering this situation, the right hand side of figure 5.2 also presents the supply and use tables that are required to include Mexico (Domestic) and Mexico (Maquiladora/M. Global) in WIOT.

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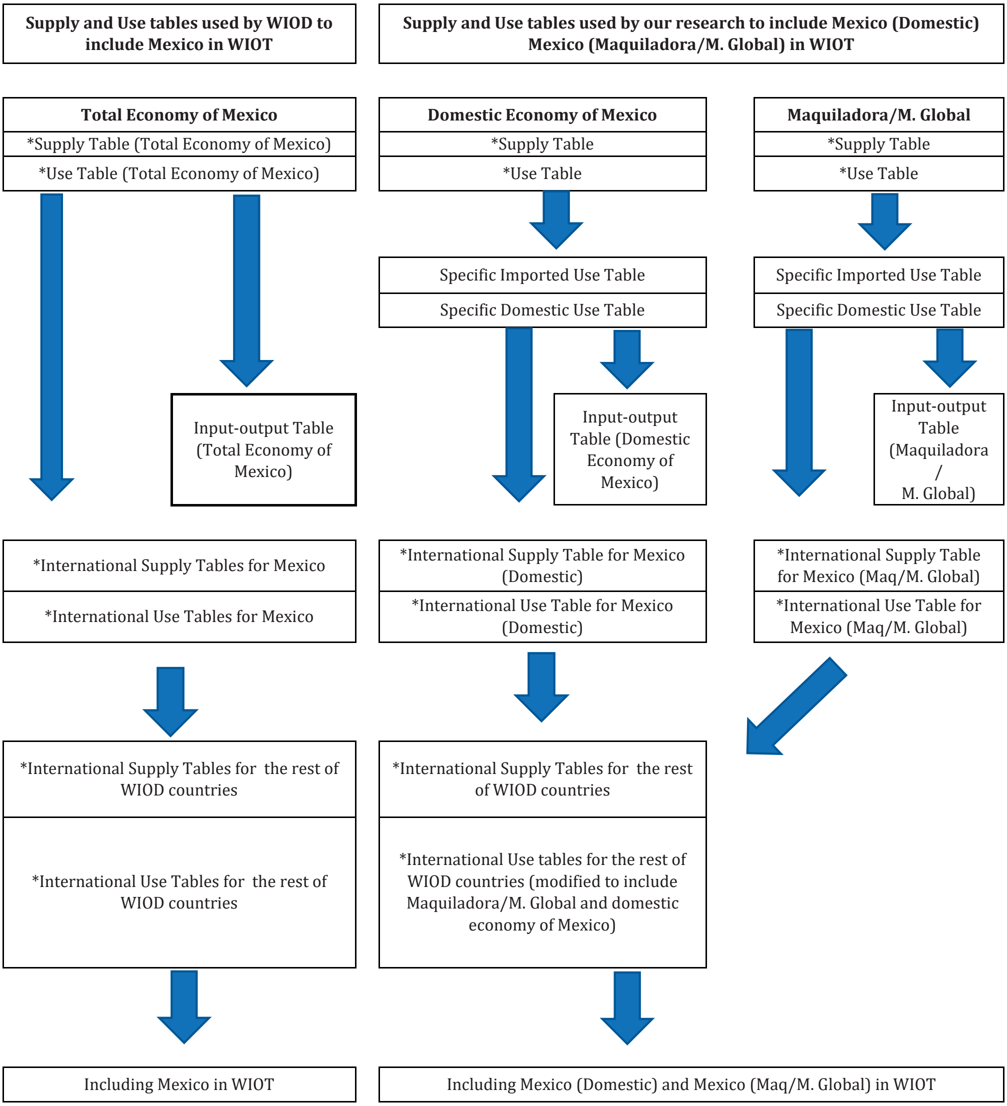
Figure (5. 2): Supply and Use Tables Required for Constructing WIOT.



We require specific supply and use tables (imported and domestic use) for the domestic economy of Mexico and for the maquiladora industry to create input-output tables and international use tables for each of these two concepts. Furthermore, we need to modify the original set up from all the international use tables from WIOD countries to include Mexico (Maquiladora/ M. Global) and Mexico (Domestic) in their original set up. The appendix A5.1 to this chapter provides a detailed methodological discussion of the steps taken to build the national and international supply and use tables for the two components of the Mexican economy, as well as our final set up of WIOTs with those included.

5.5 Data Requirements

As discussed in the previous section, including Mexico (Domestic) and Mexico (Maquiladora/Manufactura Global) into the WIOT implies creating supply and use tables - imported and domestic use tables as well as international supply and use tables - for each of the two components of the Mexican economy. Furthermore, it requires including Mexico (Domestic) and Mexico (Maquiladora/Manufactura Global) into the structure of the international use tables from each of the WIOD countries.

In order to meet these objectives, our research requires three type of data; (a) official supply and use tables (domestic and imported use) for Mexico (Domestic) and Mexico (Maquiladora/Manufactura Global) respectively, and; (b) yearly time series from the national accounting system classified according to gross production, gross value added, imported and domestic intermediate consumption, final use and, so forth. (a) and (b) will be the basis for calculating the time series SUTs for each component of the Mexican economy. Finally, the last type of data is (c) bilateral trade data by country of origin (imports) for Mexico (Domestic and Maquiladora/Manufactura Global, respectively) and by country of destination (exports) for Mexico (Maquiladora/Manufactura Global). The latter will be the input data to calculate the international use tables from Mexico (Domestic and Maquiladora/Manufactura Global) and to modify the structure of the international use table from the rest of WIOD countries. In the next lines, we will further describe the main features behind these three types of data.

5.5.1. Data for SUTs from Mexico (Domestic) and Mexico (Maquiladora/Manufactura Global).

Our research plans to create time series of extrapolated SUTs for the two components of the Mexican economy by means of the well known SUT-RAS procedure (Temurshoev and Timmer (2011). The SUT-RAS procedure requires a base matrix which is to be extrapolated with yearly data on industrial output. INEGI (the Mexican Statistical Office) provides specific data for each component of the Mexican economy to carry out this endeavor.

As mentioned already, official SUTs for the total economy of Mexico (2003) were the ones used by WIOD to include Mexico into the WIOT. In order to construct those official SUTs for 2003, INEGI first created specific SUTs for Mexico (Domestic Economy) and for Mexico (Maquiladora). This means that the sum of the SUT for Mexico (Domestic) and the ones for Mexico (Maquiladora) equal the SUT for the total economy of Mexico. Moreover, the available official use tables are further decomposed in specific imported and domestic use tables, per each component of the Mexican economy, respectively.

INEGI also separately reports yearly national accounts data for Mexico (Domestic), Mexico (Maquiladora) and Mexico (Manufactura Global). Such data is similar to the data used by WIOD in order to include Mexico in their dataset. It includes data for gross production, gross value added, imported and domestic intermediate consumption, total imports and exports and for the case of Domestic Economy final demand (note that Maquiladora/Manufactura Global do not consume final goods). All the information for the Domestic Economy of Mexico is readily available on INEGI's website (www.inegi.org.mx). The information for Maquiladora is also available from 1990 to 2006. From 2007 onwards, data for the IMMEX program is available but it is not reported in terms of the national accounting system[30]. Nevertheless, in 2014 INEGI released data for the Manufactura Global that is published in terms of the national accounts from 2003 to 2012.

With this background information in mind, we proceed to construct our own dataset as follows. The starting point was to extrapolate the official 2003 domestic (imported) intermediate use table for the Domestic economy of Mexico with yearly data of domestic (imported) intermediate consumption for that same component of the Mexican economy[31]. With this first step, we obtained time series of extrapolated domestic and imported intermediate use tables for Mexico (Domestic) from 1998 to 2011. Those domestic and imported intermediate use tables were then added up to obtain the total intermediate use table in Mexico (Domestic). Finally, once we had the total intermediate use tables for Mexico (Domestic), yearly information for the final use of Mexico (Domestic) was included in order to obtain the total use table for the Domestic economy as proposed in figure 5.2. With the corresponding specific information for Maquiladora and for Manufactura Global, our research followed the same procedure in order to create time series of extrapolated total use tables for Mexico (Maquiladora) from 1998 to 2006 and, for Mexico (Manufactura Global) from 2007 to 2011.

The same approach was followed when creating the times series of extrapolated supply tables for Mexico (Domestic) and Mexico (Maquiladora/Manufactura Global). We used the SUT-RAS procedure to extrapolate the corresponding 2003 supply table with annual data on gross output according to the respective component of the Mexican economy. Once we had the time series of supply tables, we added them their corresponding information for total imports. In that way, we finally obtained time series of total supply tables for Mexico (Domestic) and Mexico (Maquiladora/Manufactura Global), respectively for the same period of time from the total use tables. Finally, with all those tables we ensure that basic accounting identity (total supply equals total use) was met for each component of the Mexican economy.

[30] During the last years, INEGI has continuously updated the data for the IMMEX program. At the early stages of this research, IMMEX data for the total imported and domestic intermediate consumption were only reported. By 2015, such data reported per manufacturing sector has become available. Nevertheless, our research cannot use IMMEX data because official data for gross value added and gross output is still not available.

[31] From 1998 to 2006, yearly times series data for the Domestic Economy of Mexico and Maquiladora are available in current and constant prices of 2003. From 2007 to 2011, yearly times series data for Manufactura No Global and Manufactura Global are available in current and constant prices of 2008.

5.5.2 Data for the International SUTs from Mexico (Domestic) and Mexico (Maquiladora/ Manufactura Global).

In order to move from SUTs to international SUTs, Timmer et al. (2014) relied in the bilateral import data reported by each WIOD country in the UN COMTRADE database. The bilateral import data, reported at the 6 digit level from the Harmonized System (HS), was then allocated to three use categories (intermediate, final consumption and, investment) according to the Broad Economic Categories Classification (BEC). Given the lack of standardized bilateral service trade data, WIOD constructed their own database for services relying on different data sources (including OECD, Eurostat, IMF and WTO). Similarly, since there is not a service data classification for breaking services down according to the aforementioned use categories, WIOD relied on the information provided in existing import use or symmetric import IO tables.

Once all the information from international trade statistics was gathered, WIOD calculated for each use category the share of imports of product ***i*** delivered by country A in the total imports of product ***i*** received by country B in that same use category. For instance, with the international trade data, they determined for the intermediate use category the share of the imports of chemical products delivered by Canada in the total intermediate imports of chemical products received by Mexico. Finally, those shares of use categories were applied to the total imports of product ***i*** as given in the SUT time series to derive imported use values. The shares (and not the actual values) from international trade statistics were used in order to ensure consistency between the data reported in the time series of extrapolated SUT and the international SUTs.

With this background information in mind, we can indicate all the necessary data to create international SUTs for Mexico (Domestic) and Mexico (Maquiladora/Manufactura Global). Transforming SUTs into international SUTs requires bilateral trade data. INEGI reports official bilateral trade data for Mexico (Domestic) and for Mexico (Maquiladora) from 1998 to 2006. Each product category at a 8 digit level from the Harmonized System is reported in three columns; one column reporting the imports (exports) made by Maquiladora firms, a second column with the imports (exports) made by non-maquila firms and, a third column (the sum of maquila and non maquila firms) indicating the total imports (exports) made by Mexico under that 8 digit level product category. As of 2007, bilateral trade data for the total economy of Mexico is only available.

In order to further extend our analysis to more recent years and to include the Manufactura Global our research did the following. Given that Manufactura Global by definition includes all the foreign firms that mainly import intermediate goods (at least 70% of their total imports) to process them and eventually export them as a final manufacturing good, we decided to implement the same criteria in our available bilateral data. This means that within each product category at the 8 digit level from the previous data base, we identified those products whose ratio of maquiladora imports (exports) to total imports (exports) was higher than 70%. In that way, we were able to obtain a list of 8 digit level codes from the Harmonized system that were the basis to distinguish trade data for Manufactura Global within the bilateral trade data from 2007 onwards. Similarly, those 8 digit level products that did not meet our criteria for Manufactura Global trade were treated as the bilateral data for Domestic Economy from 2007 onwards.

As for the case of services, we faced the same problem as WIOD of not having a standardized service bilateral trade data base. Therefore, we decided to use the bilateral service data for Mexico provided by WIOD in their international SUTs. Given that “Other Business services” (the only service sector within Maquiladora) accounts for less than 2% of the total gross production of Maquiladora, we assumed that all the bilateral service data reported for Mexico by WIOD refer to bilateral service data of the Domestic Economy of Mexico. Nevertheless, in order to have bilateral service trade data for the maquiladora sector of “Other Business Services” we assumed that its import structure by country of origin was the same as the one reported for that same service sector in WIOD’s bilateral import data for Mexico.

Following the same reasoning, once we gathered all the necessary bilateral import data for each component of the Mexican economy, we only implemented the BEC intermediate use category to identify the intermediate goods in the Domestic Economy of Mexico. This means that we did not classify our bilateral import data in terms of the other two BEC use categories of final consumption and investment. There are several reasons for this. First of all, in my view, the bilateral import data for the Maquiladora and the Manufactura Global do not require any additional classification as their import data (by definition) belongs to their imported intermediate consumption. Second of all, our research decided not to modify the bilateral import data for final consumption and investment initially reported for Mexico in WIOD given that also, by definition, that data corresponds to the Domestic Economy of Mexico. Just remember that neither the Maquiladora nor the Manufactura Global import goods for final consumption. In addition, Maquiladora and Manufactura Global do not report any official information on their imports of capita equipment. Therefore, the structure of the international use tables from Mexico in the section of final demand and gross capital formation as initially reported by WIOD will remain completely unaltered and simply relabeled as final demand and gross capital formation for Mexico (Domestic).

The next step was to identify the imported intermediate use share of product i delivered by country A in the total intermediate imports of product i from each component of the Mexican economy. Once we obtained those shares, we applied them to their corresponding total imports of product ***i*** as given in our imported use time series to derive imported use categories. Finally, the information for gross value added, gross production and total exports was included in order to have international use tables for Mexico (Domestic) and Mexico (Maquiladora/Manufactura Global) from 1998 to 2011 as proposed in figure 5.2.

The last step before including Mexico (Domestic) and Mexico (Maquiladora/ Manufactura Global) into the WIOTs was to include those components of the Mexican economy into the structure of the international SUT from the rest of WIOD countries. In that context, we decided that the information for Mexico initially reported by WIOD in the structure of the international SUTs from the rest of WIOD countries corresponded to that of the Domestic Economy of Mexico. The main reason for this is that the Maquiladora industry only exports final manufacturing goods and by definition does not supply intermediate goods to other markets. Furthermore, exporting intermediate and final goods as well as capital goods (investment) is a role solely taken by the Domestic

Economy of Mexico. Therefore, just as in the previous case, all the data for Mexico initially contained in the international SUTs from the rest of WIOD countries will be unaltered and simply relabeled as the one for Mexico (Domestic).

Nonetheless, bilateral data for the exports of Maquiladora and of Manufactura Global is still required in order to have complete international use tables for the rest of WIOD countries. So as to meet the aforementioned objective, our research also retrieved Maquiladora bilateral export data (by country of destination) from 1998 to 2006. Data for the bilateral exports of Manufactura Global was obtained with the same criteria we followed to identify its bilateral imports. This means obtaining codes at the 8 digit level of the HS whose ratio of maquila exports to total economy exports was higher than 70% and using those codes to retrieve Manufactura Global exports by country of destination from 2007 to 2011. Afterwards, we obtain the exports share by country of origin and applied them to their corresponding total exports of product ***i*** as given in our use tables from Maquila/Manufactura Global. Finally, that information of Maquila/Manufactura Global exports by country of origin and by product category was benchmarked with the corresponding information for final use reported in each WIOD country.

Finally, with all the required international SUTs for Mexico (Domestic), Mexico (Maquiladora/ Manufactura Global) and for the rest of WIOD countries, we proceeded to construct the WIOTs from 1998 to 2011. Following WIOD, we transformed all the international SUT into a world input-output structure by means of the "fixed product-sales structure" assumption. This assumption states that each product has its own specific sales structure irrespective of the industry where it is produced. Sale structure here refers to the proportions of the output of the product in which it is sold to the respective intermediate and final demand users (Timmer et al., 2014).

Before presenting our main results, some considerations about the main methodological differences between Maquiladora and Manufactura Global should be addressed. According to INEGI (2014), Manufactura Global also includes some firms in the domestic economy of Mexico that mainly export intermediate goods to other countries to explicitly participate in global production networks. This becomes an issue because then the data for total exports in Manufactura Global does not solely include final manufactured goods (as in the case of Maquiladora exports) but also intermediate goods. In order to maintain the consistency between the data reported for the Maquiladora and that for the Manufactura Global we made the simplifying assumption that in both cases total exports consist only of final manufactured goods.

Two important factors support the assumption that intermediate exports are so modest they can be neglected. On the one hand, given that official data for the Maquiladora and for the Manufactura Global overlap from 2003 to 2006, our research can directly identify the share of Maquiladora production within Manufactura Global for those 3 years. The Maquiladora share is 71% for those years. The remaining 29% corresponds to the sum of final manufacturing exports from PITEX firms, the final goods from firms in the Domestic Economy whose production is mostly for exports[32] and, the intermediate

[32] The reader should note that Manufactura Global does not take into account the total production for exports from the Domestic Economy of Mexico. In this case, final goods from firms in the Domestic

goods produced by firms in the Domestic Economy that are exported for the production of a final good in a foreign market[33] . Unfortunately, there is no available data to find the share in Manufactura Global for the aforementioned firms. However, according to De la Cruz et al. (2011), exports of manufactured goods under the Maquiladora and PITEX programs accounted for 85.4 percent of total manufactured exports of $195.6 billion US dollars in 2006. Therefore, with those arguments in mind, we are confident that bulk of exports contained in the data for Manufactura Global refers to final manufacturing goods and that the share of exported intermediates is modest.

An alternative way to further confirm our assumption is to look at the intermediate goods delivered by Mexico to the United States, its largest trading partner that receives around 90% of its total manufacturing exports (De la Cruz et al., 2011). According to data from OECD.Stat (Trade in Value Added) recently available online, the share of Mexican intermediate goods in total intermediate imports received by the US is only 10%. This modest share can be observed from 2008 to 2011 and in all the years where data is available. Note that this 10% includes intermediate imports delivered to the US by firms in the domestic economy of Mexico. Therefore, the share of intermediate exports from Manufactura Global is substantially lower than 10%.

5.6 Sectoral Shares and Sources of Intermediate Inputs

This section presents sectoral gross output shares for the final manufacturing production from Mexico (Domestic) and Mexico (Maquiladora/M. Global), as well as their domestic and imported intermediate consumption (by country and region of origin).

Table 5.1 indicates the sectoral shares in gross manufacturing output for each of the two components of Mexican manufacturing distinguished in this paper. As can be seen, the sectoral structure of Mexico (Domestic) is more diversified than that of Mexico (Maquiladora/M. Global). The production of Mexico (Maquila/M. Global) is mainly concentrated in four manufacturing sectors namely, Electrical and Optical Equipment, Transport Equipment, Textiles and Other Manufacturing. In Mexico (Domestic) sectors with important shares in gross manufacturing output include sectors such as the Food sector, Coke and Petroleum, Chemical products, Basic Metals, Transport Equipment and so forth. A special case is that of textiles which seems to be experiencing progressively

Economy whose production is mostly for exports refers to the following; firms that are mostly foreign owned located in the domestic economy of Mexico and that import most of their intermediate goods to produce a final good to be exported. This means those firms in the domestic economy of Mexico that are meeting two of the conditions established by INEGI to be considered a firm under Manufactura Global (being mostly foreign owned and have a ratio of at least 2/3 of their imported intermediate consumption with respect to their exports). For instance, the final goods exported by firm under the domestic economy that is not foreign owned Mexico and that use mainly domestic inputs for its final good are not considered as part of Manufactura Global.

[33] Manufactura Global does not include as well the total intermediate goods exported by the Domestic Economy of Mexico. In this particular case, the intermediate goods produced by firms in the Domestic Economy that are exported for the production of a final good in a foreign market refers to the following; subsidiaries of a foreign company that were located in the domestic economy of Mexico in order to produce intermediate goods that have to be exported for the production of a final good in a foreign market. For instance, if a firm in the domestic economy produces intermediate goods to be exported but such firm is not a subsidiary from foreign company (mostly of foreign owned), then its intermediate production will not be considered as part of Manufactura Global.

declining shares in the total production within each component of Mexican manufacturing. Finally, it is worth mentioning that most of the gross output from Mexico (Domestic) is supplied to the domestic market and to the United States, while almost the entire production from Mexico (Maquiladora/M. Global) is exported to the United States.

Table (5. 1): Gross Output Shares per Manufacturing Sector: Domestic, Maquiladora and Manufactura Global.

	Mexico (Domestic)				Mexico (Maquiladora)		Mexico (M. Global)	
	1998	2006	2007	2011	1998	2006	2007	2011
Food, Beverages and Tobacco	21.1	26.6	27.2	28.9	0.5	0.9	0.9	0.6
Textiles and Textile Products	5.2	3.6	3.4	3.0	11.8	7.5	2.9	2.3
Leather, Leather and Footwear	1.5	1.0	0.9	0.8	0.6	0.3	0.2	0.2
Wood and Products of Wood and Cork	1.2	1.0	1.0	0.9	0	0	0	0
Pulp, Paper , Printing and Publishing	3.9	3.4	3.4	3.2	2.5	2	0.7	0.6
Coke, Petroleum and Nuclear Fuel	5.2	12.1	12.4	15.0	0	0	0	0
Chemicals and Chemical Products	10.5	14.8	15.1	12.5	0.2	0.2	1.8	1.9
Rubber and Plastics	2.8	3.6	3.5	3.5	2.2	3.1	1.8	1.7
Other Non-Metallic Mineral	3.8	4.4	4.4	3.7	0.6	1.9	0.7	0.5
Basic Metals and Fabricated Metal	9.2	11.3	11.0	10.8	3.3	3.3	4.4	4.4
Machinery, Nec	1.8	2.6	2.5	3.3	2	2.3	2.1	3.6
Electrical and Optical Equipment	14.8	5.1	4.9	4.0	51.6	54	46.4	38.4
Transport Equipment	16	8.3	8.2	8.2	17.8	17.5	32.3	38.5
Manufacturing, Nec; Recycling	3	2.3	2.2	2.2	6.9	7.1	5.9	7.3
Total	100	100	100	100	100	100	100	100

Source: as described in section 5.5

The data in table 5.1 reveal the pattern of specialization of the maquiladora industry during the last decade. The fact that the production of maquiladora is only concentrated in four manufacturing sectors suggests that producers supplying foreign markets have specialized in the sectors where Mexico has the greatest competitive advantages, Here, we are referring to the production of goods with a high weight-to-value ratio (fridges, non-collapsible furniture, etc), those that involve just-in-time procedures (transport equipment) , those that benefit from NAFTA regulations (the production of flat-screens) and so forth.

The steady decline in the textile production for exports is associated with the emergence of more efficient producers in East Asia, which are strongly specialized in textiles and represent fierce competition for maquiladora producers. The response of maquiladora firms was to specialize in the manufacture of other textile goods, such as cotton products. These are the goods for which NAFTA offers the greatest protection for maquila producers. Finally, the diversified structure of Mexico (Domestic) indicates that this segment of the Mexican manufacturing sector is not practicing the pattern of specialization observed in Mexico (Maquiladora/M.Global). This is because the production of Mexico (Domestic) is mainly supplied to the domestic market and does not face significant pressures from foreign low-cost producers.

Table 5.2 presents the intermediate consumption for the total manufacturing production of Mexico (Domestic) and for three important sectors within that segment of the economy[34].This table explicitly indicates the origin of the intermediate inputs (domestic or specific country or region of origin).

Table (5. 2): Intermediate Inputs used in manufacturing in Mexico (Domestic), by Region of Origin (%)

	Total Manufacturing production		Textile and Textiles products		Electrical and Optical Equipment		Transport Equipment	
	1998	2011	1998	2011	1998	2011	1998	2011
Mexico (Domestic)	70.6	67.0	76.3	69.9	40.8	31.5	53.8	54.8
NAFTA								
United States	20.0	19.9	15.7	18.7	38.4	36.0	36.6	26.2
Canada	0.6	1.1	0.2	0.2	1.0	1.0	1.1	1.6
East Asia								
China	0.3	2.2	0.1	4.3	1.5	9.6	0.1	2.7
Japan	1.1	1.5	0.2	0.1	4.0	5.5	1.4	6.3
South Korea	0.3	0.6	1.7	0.6	0.3	1.6	0.0	0.8
Taiwan	0.3	0.3	0.7	0.6	1.2	1.2	0.3	0.3
Europe								
Germany	1.9	1.6	0.5	0.5	4.3	3.7	5.2	3.1
France	0.5	0.4	0.1	0.1	1.7	1.3	0.2	0.3
United Kingdom	0.3	0.2	0.1	0.1	0.6	0.4	0.1	0.1
Rest of Europe	1.8	2.3	1.2	1.7	4.0	3.3	0.6	1.9
Rest of the World	2.2	2.9	3.0	3.1	2.2	5.0	0.6	1.9
Total intermediate inputs	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Sources: as described in section 5.5.

In this table 5.2, we observe that from 1998 to 2011, Mexico (Domestic) itself is the main source of intermediate goods used by the manufacturing firms in Mexico (Domestic). During those years, the share of Mexico (Domestic) in the total intermediate goods used by Mexico (Domestic) is more than 70% with little variation over time. The share of the US is 20%, while the other countries account for the remaining 10%.

The aggregate pattern in which Mexico (Domestic) supplies most of the intermediate inputs used by Mexico (Domestic), can also be observed for two of the three subsectors included in the table. During the years under consideration, the Transport sector sourced more than 54% of its intermediate inputs from Mexico (Domestic), The corresponding figure for textiles was more than 70%. Electrical and Optical equipment is the only exception. In 1998, this sector was primarily using intermediate goods produced by Mexico (Domestic) producers. By 2011 US accounted for the highest share

[34] We decided to focus on the trends observed in the Electrical and Optical Equipment sector, Transport Equipment and Textiles and Textiles products both for the case of Mexico (Domestic) and Mexico (Maquiladora/M. Global). In my view point, analyzing those sectors allows us to better understand the new pattern of manufacturing specialization at the Maquiladora industry. According to table 5.1, since 1998, Electrical and Optical Equipment and Transport Equipment represent more than 70% of the total manufacturing production in Maquiladora. The textile industry also provides an interesting case, given the dramatic decline of its share in total maquiladora output (from 11% in 1998 to 2.3% in 2011). Finally, we extend the analysis of those sectors for the case of Mexico (Domestic) to allow for comparison between the two segments of Mexican manufacturing.

of intermediates, while there had been dramatic increases in the share of China. Japan and South Korea also increased their intermediate input shares between 1998 and 2011.

Table 5.3 presents the origin of intermediate inputs for Maquiladora (upper panel) and Manufactura Global (lower panel). There are substantial differences compared to the figures for Mexico (Domestic) in table 2. In 1998, US producers provided more than 84% of the total intermediate inputs used by Maquiladora firms. Only 8.5% was sourced from Mexico (Domestic). The remaining 12% consisted of intermediate goods from the rest of the world. By 2006, the US share had dropped to 42.5 per cent, while the shares of East Asia and the rest of the world increased dramatically. By 2011 a dramatic diversification had taken place, as can be observed in the figures for the intermediate input structure of Manufactura Global. In that year, US producers provided 32% of the total intermediate goods, East Asian countries 30%, Mexico (Domestic) 22.5% and Europe 7.1% with the remaining share coming from the rest of the World.

The steady and sharp decline of the US share in intermediate goods in Maquiladora/M. Global can be observed in every single manufacturing sector. In the case of the textile industry, the decline in US shares was accompanied by a slight increase in the intermediate inputs supplied by Mexico (Domestic) and a steady (but still modest) increase of East Asian inputs. In the case of Transport Equipment, the decline in US inputs is mainly associated with a continuous increase in the inputs supplied by Mexico (Domestic) and, to a lesser extent, to the inputs produced in Europe and East Asia. The most interesting case is the Electrical and Optical Equipment sector, which is the largest sector within Maquiladora/M. Global. As of 2006 East Asia became the most important supplier of intermediate inputs. In 1998, the share of East Asian countries in the intermediate inputs of this sector was only 8%. By 2011, it had increased to 50%. The share of US inputs declined from 84% to 27%, while the share of Mexico (Domestic) nearly doubled (from 5% to 10%) during the period under consideration

Our data indicate that the increasing globalization of production has had different effects on the domestic and imported origin from the inputs used by each segment of the Mexican manufacturing production. First of all, over the last decade, firms in Mexico (Domestic) have remained highly dependent on the intermediate inputs also produced by Mexico (Domestic). Drastic reductions in transport and communications costs have only altered the intermediate input structure in the Electrical and Optical equipment sector that receives more of its intermediate inputs from US and from East Asia than from Mexico (Domestic). Nevertheless, that change is compensated by the relatively unchanged intermediate input structure of the rest of the manufacturing sectors.

Table (5. 3): Share of Intermediate Inputs used in the Manufacturing Production from Mexico (Maquila) and Mexico (Manufactura Global).

Mexico (Maquiladora)

	Total Manufacturing production		Textile and Textiles products		Electrical and Optical Equipment		Transport Equipment	
	1998	2006	1998	2006	1998	2006	1998	2006
Mexico (Domestic)	8.5	10.9	12.5	16.0	5.6	6.8	7.5	14.2
NAFTA								
United States	84.5	42.5	85.2	71.0	83.6	29.5	90.2	62.4
Canada	0.3	1.3	0.2	1.5	0.3	0.8	1.0	5.9
East Asia								
China	0.6	12.7	0.2	5.2	0.8	16.2	0.5	4.1
Japan	1.8	7.9	0.1	0.4	2.8	12.6	0.2	3.5
South Korea	1.7	7.6	0.4	0.8	3.0	12.6	0.0	2.3
Taiwan	0.8	3.6	0.5	0.9	1.1	5.9	0.5	0.3
Europe								
Germany	0.2	1.0	0.1	0.5	0.2	1.0	0.0	1.5
France	0.2	0.3	0.0	0.1	0.3	0.3	0.0	0.2
United Kingdom	0.0	0.4	0.0	0.1	0.0	0.3	0.0	1.0
Rest of Europe	0.2	1.6	0.2	0.9	0.2	1.7	0.0	1.2
Rest of the World	1.3	10.2	0.5	2.7	2.0	12.2	0.1	3.5
Total intermediate inputs	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Mexico (Manufactura Global)

	Total Manufacturing production		Textile and Textiles products		Electrical and Optical Equipment		Transport Equipment	
	2007	2011	2007	2011	2007	2011	2007	2011
Mexico (Domestic)	19.7	22.5	17.2	17.6	11.5	10.1	31.8	40.1
NAFTA								
United States	35.0	32.2	61.0	53.6	27.2	26.6	46.1	39.5
Canada	1.4	1.3	1.5	2.0	0.8	0.6	3.7	3.1
East Asia								
China	12.7	17.5	5.7	9.7	17.2	27.7	1.8	2.0
Japan	6.6	5.3	0.5	0.3	10.5	9.4	4.6	5.2
South Korea	6.8	5.1	0.7	1.0	13.4	10.1	0.5	1.6
Taiwan	3.0	1.6	1.2	1.0	5.5	2.8	0.4	0.5
Europe								
Germany	2.8	2.8	1.1	1.7	2.1	2.6	5.9	4.2
France	0.6	0.7	0.2	0.1	0.4	0.4	0.5	0.4
United Kingdom	0.5	0.5	0.1	0.1	0.3	0.3	0.2	0.1
Rest of Europe	2.9	3.1	3.9	3.6	2.3	2.3	1.5	1.8
Rest of the World	8.2	7.4	7.0	9.3	8.9	7.2	2.9	1.6
Total intermediate inputs	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: as described in section 5.5

On the other hand, firms in Mexico (Maquiladora/M. Global) faced major changes in the domestic and foreign origin of their intermediate consumption. In my view, these changes are a response of maquiladora to its new pattern of specialization. In order to properly take advantage of the benefits offered by NAFTA, by the Maquiladora/IMMEX program and by the areas where Mexico offers a competitive advantage, the export producers had to drastically modify the sourcing of their intermediate inputs.

At the aggregate level, Maquiladora substantially reduced its dependence on US intermediate inputs in favor of progressively more inputs from East Asia (China). At the sectoral level, however, a more diversified structure of intermediate sourcing is observed with some sectors using more inputs from China, other sectors using more inputs from the US and, some others more from Mexico.

In sum, we may draw the following conclusions with regard to the manner in which Mexican manufacturing industry responds to the increasing globalization of production. Firms mostly producing for the domestic market (those in Mexico-Domestic) operate in the context of local value chains with most of the value being added by Mexico-Domestic. The firms producing for exports (those in Mexico-Maquiladora) are part of local, regional and global value chains. Whether firms in Maquiladora belong to local, regional or global value chains depends on the types of goods being produced, trade and tariff incentives, as well as the competitive advantages offered by Mexico. This will be further examined in our value added calculations in the next section.

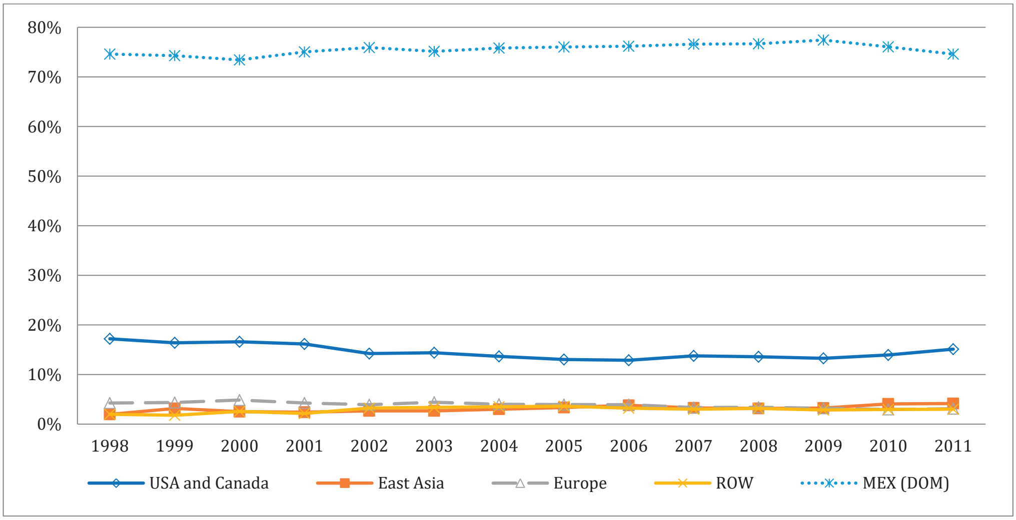
5.7 Results: the Structure of Value Added Contributions

This section describes the structure of value added contributions embodied in the final manufacturing output (at industry and sector level) of the different segments of the Mexican manufacturing sector: Mexico (Domestic), Mexico (Maquiladora/M. Global) and Mexico (Total economy). The question here is which countries and regions capture most of the value added embodied in Mexican manufacturing production and to what extent Mexico itself profits from its manufacturing production. The value added contributions have been derived using equation (5.1) and distinguish both domestic and foreign value added content (by country and region of origin). Particular attention is paid to the value added contributions of Mexico and the different patterns found for Mexico (Maquiladora/M. Global) and Mexico (total economy).

5.7.1. The Domestic Economy of Mexico

Figure 5.3 indicates the structure of value added contributions by region of origin in the aggregate final manufacturing output of the Mexican Domestic sector (Mexico Domestic) from 1998 to 2011. The figure shows that the value added contribution from Mexico (Domestic) and from different regions did not change much over time. The value added contribution from Mexico (Domestic) was always above 74%. US/Canada and Europe saw their contribution decrease at the expense of an increase in the East Asian contribution. East Asian countries more than doubled their combined value added contribution in the final output from Mexico (Domestic). By 2009 their share is higher than that of Europe. Nevertheless, the value added from both East Asia and Europe remains significantly lower than that of US/Canada.

Figure (5. 3): Share of value added content of total final manufacturing output in Mexico (Domestic), by region of origin.



Source: Author's calculation based on WIOT including Mexico (Maq/M.Global) and Mexico (Domestic) and using equation (5.1).
Notes: ROW stands for Rest of the World.

Table 5.4 presents the evolution of the structure of value added contributions for three manufacturing sectors in Mexico (Domestic) for selected years[35].

As at the aggregate level, the three sectors have remarkably high and stable domestic contributions to value added. Electrical and Optical equipment is the only exception. This is the manufacturing sector in Mexico (Domestic) with the lowest domestic value added contribution, which has also been declining over time (45% in 1998 and 39% by 2011). The increase of the contributions of East Asian countries is responsible for this decline as well as for the decline of the shares of US/Canada and Europe within the same sector. The East Asian share doubled from 6.7% in 1998 to 14.7% in 2011. According to our data, China drives this increase, in the light of its tenfold increase in value added share in this short period.

In sum we may infer that the increasing value added contribution from East Asian countries (notably China) in the Electronic and Optical equipment produced by Mexico (Domestic) is the factor driving the increase in the value added contribution of this region in the aggregate output of Mexico (Domestic). Nevertheless, the East Asian share in total industry still remains modest, given the remarkably shares of high value added originating in Mexico (Domestic) and the importance of NAFTA neighbors (US/Canada) in most of the other manufacturing sectors.

[35] In section 5.5.1, we mentioned the reasons why this research decided to focus only on three manufacturing sectors. Nevertheless, the appendix A5.2 to this research provides the evolution of the structure of the value added contribution for all manufacturing sectors from 1998 to 2011. Such information is provided both for Mexico (Domestic) and Mexico (Maquila/M. Global).

Table (5. 4): Share of Regional Value Added Content Embodied in Final Manufacturing Output Produced by Mexico (Domestic). Selected Manufacturing Sectors.

Textiles and Textile Products

	Domestic Economy of Mexico			
Region	**1998**	**2000**	**2005**	**2011**
USA and Canada	17.0	18.6	13.9	12.4
East Asia	2.8	3.8	4.5	4.0
Europe	2.9	2.7	3.4	2.2
ROW	3.2	2.9	3.7	3.0
MEX (DOM)	74.1	71.9	74.6	78.5
Total final output	100	100	100	100

Transport Equipment

	Domestic Economy of Mexico			
Region	**1998**	**2000**	**2005**	**2011**
USA and Canada	27.0	26.7	22.2	19.0
East Asia	2.0	2.9	3.6	7.8
Europe	5.1	5.4	6.0	4.5
ROW	1.2	1.8	3.2	3.0
MEX (DOM)	64.7	63.2	65.0	65.7
Total final output	100	100	100	100

Electrical and Optical Equipment

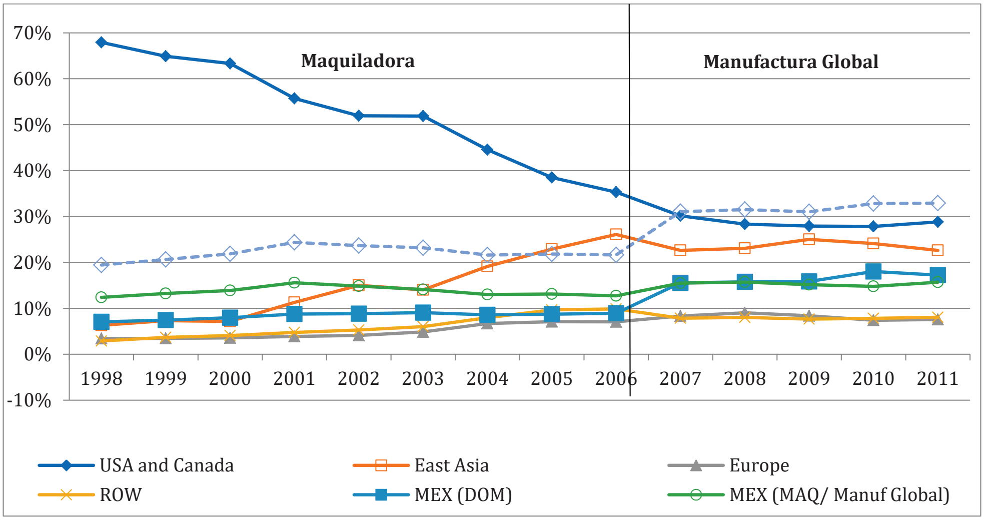
	Domestic Economy of Mexico			
Region	**1998**	**2000**	**2005**	**2011**
USA and Canada	35.3	32.5	23.8	31.0
East Asia	6.6	7.8	15.7	14.7
Europe	10.0	11.5	11.9	8.3
ROW	3.0	6.0	8.0	6.7
MEX (DOM)	45.2	42.2	40.7	39.3
Total final output	100	100	100	100

Source: as described in figure (5.3).

5.7.2 Maquiladora Industry (1998-2006) and Manufactura Global (2007-2011)

Compared to Mexico (Domestic), a completely different story can be observed in the case of structure of value added shares in Mexico (Maquiladora/M. Global). Figure 5.4 presents the value added contribution by country of origin in the aggregate final manufacturing output produced by Mexico (Maquiladora/M. Global). Given the difference in coverage of the firms included in the Maquiladora industry and those included in Manufactura Global, figure 5.4 is divided into two panels, the first referring to Maquiladora, the second to Manufactura Global.

Figure (5. 4): Value Added Contribution (by Country of Origin) in Mexico (Maquiladora/M. Global). Total Final Manufacturing Output.



Source: as described in figure (5.3).

As mentioned previously, the domestic value added contributions from Mexico (Maq./M. Global) and from Mexico (Domestic) are considered separately for the case of final manufacturing output produced by Mexican Maquiladora/Manufactura Global sector. The sum of the value added contribution from Mexico (Maq./M.Global) and from Mexico (Domestic) is equal to the total domestic value added embodied in the Maquiladora/M. Global final manufacturing production. This total domestic value added contribution is also represented in figure 5.4 as Mexico (Total). For all years in figure 5.4 for which data for the Maquiladora were available, we observed that value added share of Mexico (Maquiladora) was higher than that of Mexico (Domestic) with 12.4% versus 7.1% in 1998 and 12.7% versus 8.9% by 2006, respectively. When considering the joint contribution from Mexico (Maquiladora) and Mexico (Domestic), i.e. the total domestic value added contribution in Maquiladora production represented by Mexico (Total), we observed the same cyclical behavior – increases till 2001, decreases thereafter – as described in chapter 4.

In my view, this cyclical behavior is mainly related to external shocks and changes in the international trade environment and not to changes in the domestic regulatory environment. Our detailed data allow us to conclude that those external shocks have mainly affected the value added contributions from Mexico (Maquiladora), with the contributions from Mexico (Domestic) remaining unaltered. The US crisis and China's entrance to the World Trade Organization (WTO) in 2001 (the first external shock considered in our research) induced a steady decline in the value added contribution from Mexico (Maquiladora) from a peak 15.6% in 2001 to 12.7% in 2006. This went hand in hand with a loss in employment experienced by maquila producers after 2001.

We see that the value added contribution from Mexico (Domestic) in Maquiladora production did not significantly change over time. It even showed a marginal increase from 7% in 1998 to 9% in 2006. The value added contribution from Mexico (Domestic) is perhaps the most relevant one, given that it reflects the degree to which Mexican manufacturing suppliers succeed in interacting more effectively with foreign producers in order to trigger more benefits of exports for the rest of the economy (inducing for instance a process technological learning). The fact that the value added contribution in Maquiladora production remained below 9%, indicates that Mexican suppliers were unable to meet the input requirements of foreign firms producing for export in Mexico.

From 2007 onwards. we see that the value added contribution from Mexico (Domestic) in the total final manufacturing output from Mexico (Manufactura Global) is higher than the one from Mexico (Domestic) in Mexico (Maquiladora). This is linked to the increase in the value added contribution from Mexico (Domestic) between 2006 and 2007, when the analysis shifts from Mexico (Maquiladora) to Mexico (Manufactura Global) in figure 5.4. The main factor behind the higher value added from Mexico (Domestic) embodied in Mexico (Manufactura Global) is that the corresponding data for Manufactura Global include not only the Maquiladora firms, but also those in the PITEX program, new IMMEX firms, as well as firms in the Domestic Economy that are highly engaged in global production networks. Therefore, the figures from 2007 to 2011 are not strictly comparable to those from 1998 to 2006.

Despite its higher value from 2007 to 2011, the trend in the value added contributions from Mexico (Domestic) in the total final manufacturing output of Mexico (Manufactura Global) is similar to that from 1998 to 2006. There is a modest net increase in its share (from 15.5% in 2007 to 17.2% in 2011) and just as in the case of Maquiladora, the share does not seem to have been severely affected by external shocks (in this case the financial crisis in 2008).

The value added contribution of Manufactura Global to its own final output shows more volatility. During the transition from Mexico (Maquila) to Mexico (M. Global), the value added contribution from Maquiladora increases from 12.7% in 2006 to 15.6% by 2007. As in the case of Maquiladora, Mexico (Manufactura Global) seems to be sensitive to external shocks. As a result of the financial crisis in 2008, the value added contribution from Mexico (Manufactura Global) decreased from 15.7% in 2008 to 14.8% in 2010, with some recovery by 2011. The value added decrease after 2008 reflects the hiring of less workers as a result of firms under Manufactura Global reducing their output or shutting down.

In my view, the value added contributions from Mexico (Manufactura Global) and Mexico (Domestic) in the total final manufacturing output of Mexico (M. Global) from 2007 to 2011 follow patterns similar to those observed for Mexico (Maquiladora) between 1998 and 2006. On the one hand, given the lack of variation and lack of substantial increase observed in the contribution from Mexico (Domestic), we may conclude that manufacturing firms in Mexico supplying domestic inputs to IMMEX firms (and to those other firms highly engaged in global production networks) are still far from meeting the requirements of foreign producers. These producers seek to export to one of the major markets in the World (the United States) and Mexican suppliers to Manufactura Global have not been able to meet their competitive standards. When comparing the contribution from Mexico (Domestic) and Mexico (Manufactura Global) in the total output from Manufactura Global, we can see that contribution from Mexico (Domestic) has become slightly higher than that of Mexico (M. Global). Nevertheless, just as in case of Maquiladora, the fluctuations in the total domestic value added embodied in M. Global can still be attributed to the changes in the value added contributions from Manufactura Global.

Figure 5.4 also indicates the value added contribution from non-Mexican countries in the final manufacturing production of Mexico (Maquiladora) and Mexico (Manufactura Global). We observe a dramatic decline in the value added contribution from US/Canada producers over time. In 1998, the value added contribution from US/Canada producers to the total final manufacturing output from Mexico (Maquiladora) was 68%. By 2006, the last year for which Maquiladora data was available, the US/Canada value added contribution had declined to 35%. This decline continues from 2007 to 2011. By 2011 the share of US/Canada was 29%. Given the small increases and minor variations in the total domestic value added embodied in the final manufacturing output of Maquiladora and M. Global, we can indicate that an increase in the value added contribution from East Asian producers was mainly achieved at the expense of the US/Canada value added contributions to final output

In 1998, the joint value added contribution from East Asian producers in the final manufacturing output from Mexico (Maquiladora) was 6.3%. At that time, it was already larger than the share of Europe (3.4%) and that of the rest of the world (2.7%), but it was ten times smaller than the joint contribution from US/Canada. In 2006, the joint contribution from East Asia in Maquiladora production was of 26%. In 2011 its contribution was 23% of the final output in Manufactura Global. During those years, the country that was mainly driving the increasing East Asian value added content was, of course, China. By 2005, the individual contribution from China in Maquiladora production surpassed that of Japan and by 2011, Chinese producers accounted for half of the total East Asian value added embodied in Manufactura Global final manufacturing output.

We find that during the last decade (the 2000s) the increasing globalization of production induced two effects in the value added structure embodied in the Mexican production of final manufactured goods that are mainly exported to the US. On the one hand, it induced dramatic shifts in the value added contributions from foreign producers participating in the production of Mexico (Maquila/Manufactura Global), with NAFTA neighbors adding progressively less value added in the total final manufacturing output and East Asia steadily adding more and more. This is the consequence of US producers outsourcing increasing parts of production for intermediate use to Asia. Thus global value chains become more complicated. In the earlier period, producers in the USA provide inputs to Mexican producers, producing final goods for the US market. Later, American producers relocated their activities to Asia and provide inputs for Mexican exporters via Asia.

On the other hand, the increasing globalization of production did not significantly alter the structure of domestic value added contributions to Mexico (Maquiladora/M. Global). From 1998 to 2006, the value added contribution from the firms in the Domestic Economy of Mexico did not show any signs of dramatic increase or decline due to the increasing globalization of production faced by Maquila producers. Similarly, the corresponding value added of Mexico (Domestic) embodied in Manufactura Global from 2007 to 2011 does not seem to have changed drastically. In this context, the variations in the total domestic value added of Mexico (Maquiladora/M. Global) mainly reflect the response (expansion/contraction) of the volume of low qualified employment to the external shocks in 2001 and 2008.

In the end, the main outcome induced by the increasing globalization of production during the 2000s has been a drastic diversification in the value added contributions by country of origin to the final manufacturing output in Mexico (Maquiladora/M. Global). According to figure 5.4, this process of value added diversification has become more pronounced since 2005 and it has become deeper over time. For instance, by 2010 the domestic value added contribution of Mexico (Total) in Manufactura Global production was 33%, that of US/Canada was 28%, the of East Asia 24%, that of Europe 8.4% and that of the rest of the World 7.7%.

Table 5.5 presents the structure of value added contributions per manufacturing subsector for selected years for Mexico (Maquiladora) and Mexico (M. Global) respectively. As can be seen, the decline in the shares of US/Canada producers and, the corresponding diversification of the value added structure observed at the aggregate level can also be observed at the sectoral level. In the case of the textile industry, we see that loss in US/Canada value added contributions went hand in hand with gains of textile producers in East Asia (notably China), but also of those in Europe and the rest of the World. The joint contribution from Mexico (Domestic) and Mexico (Maquiladora/Global), i.e. the total domestic value added embodied in the final manufacturing output remained between 28 and 33% and thus it was not drastically modified. Once more, we can see that firms in Mexico (Domestic) supplying inputs to Maquiladora/M. Global were unable to profit from the decline in US/Canada value added and did not increase their share in value added contributions. The value added from Maquiladora/M. Global suffered minor variations related to the sensitivity to the external shocks in 2001 and 2008.

The most drastic change can be observed in the case of the Electric and Optical equipment. In Mexico (Maquiladora) from 1998 to 2006, the US/Canada share in value added embodied in final manufacturing output declined from 70% to 28%, while East

Asia increased its share from 9% to 38%. Such trends continued in the years for which data for Mexico (Manufactura Global) were available. By 2011, the corresponding share for East Asia was 39% while that of US/Canada was 26%. Just as in the case of the textile industry, the contribution of Mexico (Domestic) and Mexico (Maquiladora/M. Global) remained low and did not change substantially.

Transport equipment shows a somewhat different trend in its value added structure. Here, we can also see that the value added contribution of US/Canada has substantially declined both in the case of the final output in Mexico (Maquiladora) and in Mexico (Manufactura Global). But in this industry, these declines go hand in hand with increasing value added contributions from Mexico (Domestic) and Mexico (Maquiladora/M. Global). From 1998 to 2006, it can be seen that firms in Mexico (Domestic) nearly doubled their value contribution in the final output of the transport sector from Mexico (Maquiladora). The value added from Mexico (Maquiladora) also steadily increased, despite a temporary contraction as a result of the external shock in 2001. The joint value added contribution from firms Mexico to the final transport production in Mexico (Maquiladora) increased from 20% in 1998 to 29% by 2006.

In the years after 2007 when the data for Mexico (Maquiladora) are replaced by data for Mexico (Manufactura Global), we see that the corresponding value added for Mexico (Domestic) nearly doubles from 2006 to 2007. This situation is mainly because of the larger population of firms included under the concept of Manufactura Global. Nevertheless, between 2007 and 2011 we also see that general upward trend for the automotive sector in the Maquiladora also continues in the case of the Manufactura Global. There is a continuous decline in US/Canada value added contributions , while the value added share of Mexican firms increases. By 2011, the value added contribution from Mexico (total economy) in the transport equipment sector from Manufactura Global was 50%, the one from US/Canada 31%, East Asia 8.6%, Europe 6.1% and the rest of the world 4%.

Table (5. 5): Share of Regional Value Added Embodied in Final Manufacturing Output Produced by Mexico (Maquiladora/M. Global). Selected Manufacturing Sectors.

Textiles and Textile Products

	Maquiladora		**M. Global**	
Region	**1998**	**2000**	**2005**	**2011**
USA and Canada	64.4	51.6	46.8	39.0
East Asia	2.7	7.7	8.5	12.3
Europe	3.0	4.3	6.6	6.3
ROW	1.9	4.6	6.8	8.8
MEX (DOM)	9.4	11.7	12.5	12.3
MEX (MAQ/ Manuf Global)	18.7	20.2	18.9	21.3
Total final output	100	100	100	100

Transport Equipment

	Maquiladora		**M. Global**	
Region	**1998**	**2000**	**2005**	**2011**
USA and Canada	71.7	49.6	35.4	31.3
East Asia	3.5	10.1	7.4	8.6
Europe	3.2	6.1	7.6	6.1
ROW	2.1	5.9	4.5	3.9
MEX (DOM)	6.5	11.4	22.8	28.1
MEX (MAQ/ Manuf Global)	13.0	17.0	22.2	22.1
Total final output	100	100	100	100

Electrical and Optical Equipment

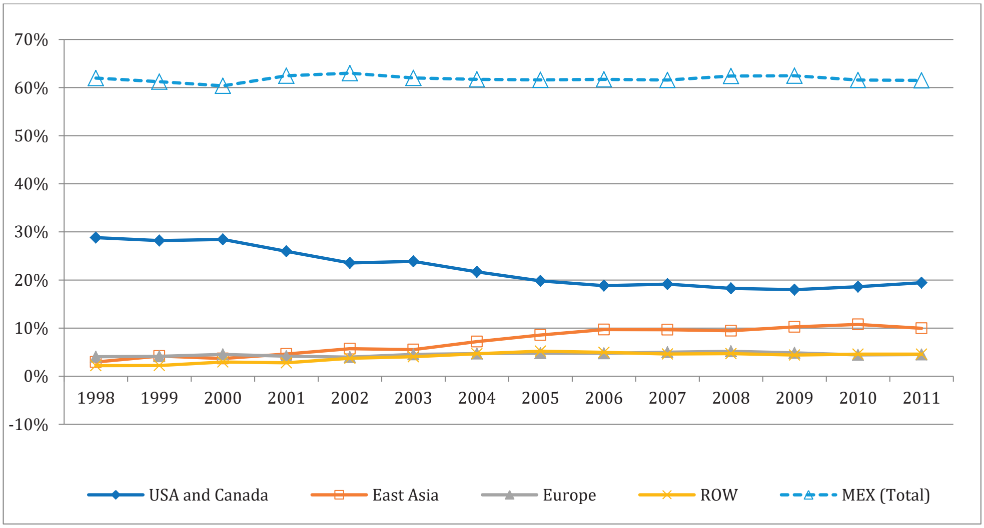
	Maquiladora		**M. Global**	
Region	**1998**	**2000**	**2005**	**2011**
USA and Canada	69.6	28.1	26.1	25.7
East Asia	8.7	37.9	36.3	39.2
Europe	3.8	7.8	8.6	7.8
ROW	3.6	11.4	9.8	10.6
MEX (DOM)	5.0	6.0	9.9	8.6
MEX (MAQ/ Manuf Global)	9.3	8.8	9.4	8.2
Total final output	100	100	100	100

Source: as described in figure (5.3)

5.7.3 Total Economy of Mexico (1998-2011)

Figure 5.5 presents the evolution from the structure of value added contributions embodied in the final manufacturing output produced by the total economy of Mexico. The figures were obtained by adding the value added structure from Mexico (Domestic) and the one from Mexico (Maquiladora/M. Global).

Figure (5. 5): Value Added Contribution (by Country of Origin) in Mexico (Total Economy) Final Manufacturing Output.



Source: as described in figure (5.3).

The figure shows that the value added structure of Mexico (total economy) resembles the value added structure of Mexico (Domestic). As before, we observe that the substantial decline in the US/Canada value added embodied in Maquiladora/M. Global production is largely dampened by the value added contribution from US/Canada in the final output from Mexico (Domestic). As a result the decline of the value added contribution of US/Canada in the total manufacturing sector in figure 5.5 is less dramatic than in figure 5.4.

Figure 5.5 also indicates an increasing contribution from East Asia in the total final manufacturing output produced in the total economy of Mexico. According to our data, the main source of this increase is the higher levels of value added from East Asian producers identified in the production of Electrical and Optical Equipment by Mexico (Domestic) and, to a much greater extent, in the production of Electrical and Optical Equipment by Mexico (Maquiladora/M. Global).

Our data also allow us to break down each country's value added contributions in the total final manufacturing output of Mexico (total economy), according to whether these contributions are made in the domestic sector or in the Maquiladora/Manufactura General sector. The data are reproduced in table 5.6.

Table (5. 6): Share in Value Added Content of Final Manufacturing Output by Region/Country of Origin in Mexico (Total Economy).

		Total Manufacturing production		Textile and Textiles products		Electrical and Optical Equipment		Transport Equipment	
		1998	2011	1998	2011	1998	2011	1998	2011
Mexico	(Domestic Mx)	57.5	51.1	44.1	58.4	23.1	16.0	50.9	34.2
	(Domestic to MAQ/M.G.)	1.6	5.4	3.8	3.1	2.5	5.1	1.4	13.5
	(MAQ/M.G.)	2.8	4.9	7.6	5.4	4.5	4.9	2.8	10.6
	Total Mexico	62.0	61.5	55.4	67.0	30.1	25.9	55.1	58.3
United States	(Domestic Mx)	12.7	9.7	9.9	8.9	17.5	12.1	20.5	9.2
	(MAQ/M.G.)	15.2	8.5	25.7	9.5	33.4	14.7	14.9	13.8
Canada	(Domestic)	0.6	0.6	0.3	0.3	0.6	0.6	0.8	0.7
	(MAQ/M.G.)	0.3	0.6	0.5	0.5	0.6	0.6	0.4	1.2
	Total US and Canada	28.8	19.4	36.3	19.2	52.0	27.9	36.5	24.9
China	(Domestic Mx)	0.3	1.4	0.2	2.2	0.7	3.2	0.1	1.3
	(MAQ/M.G.)	0.2	3.8	0.3	2.4	0.6	12.6	0.2	1.5
Japan	(Domestic Mx)	0.9	1.1	0.3	0.2	2.0	1.9	1.1	2.3
	(MAQ/M.G.)	0.7	1.9	0.4	0.3	2.1	5.5	0.3	2.0
South Korea	(Domestic Mx)	0.2	0.2	0.8	0.3	0.2	0.5	0.1	0.3
	(MAQ/M.G.)	0.3	1.1	0.2	0.2	1.1	3.8	0.1	0.5
Taiwan	(Domestic Mx)	0.2	0.1	0.3	0.2	0.5	0.4	0.2	0.1
	(MAQ/M.G.)	0.2	0.4	0.2	0.2	0.6	1.3	0.1	0.2
	Total East Asia	3.0	10.0	2.7	6.1	7.6	29.2	2.3	8.2
Germany	(Domestic Mx)	1.3	0.7	0.4	0.4	1.9	1.2	2.6	1.0
	(MAQ/M.G.)	0.2	0.8	0.2	0.4	0.4	1.6	0.1	1.3
France	(Domestic Mx)	0.4	0.2	0.2	0.1	0.8	0.4	0.2	0.2
	(MAQ/M.G.)	0.1	0.2	0.2	0.1	0.3	0.4	0.1	0.2
United Kingdom	(Domestic Mx)	0.3	0.2	0.2	0.1	0.5	0.2	0.3	0.1
	(MAQ/M.G.)	0.2	0.2	0.2	0.1	0.3	0.4	0.1	0.2
	Rest of Europe	1.6	2.2	1.5	2.1	2.7	3.7	1.2	2.2
	Total Europe	4.1	4.5	2.9	3.2	6.9	8.0	4.7	5.3
	Rest of the World	2.2	4.6	2.7	4.5	3.3	9.0	1.4	3.4
	Total final manufacturing production	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: as described in figure (5.3).

First of all, firms in Mexico (Domestic) account for the largest share in the total value added structure of Mexico (total economy). The contribution of the domestic component decreased during the years studied here (from 57.5% in 1998 to 51.1% in 2011). Second, the value added contribution from the firms in Mexico (Domestic) sourcing intermediate inputs to firms in Mexico (Maquiladora/M. Global) increased from 1.6 to 5.4%. Finally, the value added contribution from the firms in Mexico (Maquiladora/M. Global) was less than 5% with some decline due to the external shocks of 2001 and 2008.

Of the three key manufacturing sectors considered in this paper, Transport Equipment and Textile products are the sectors that contribute the most to the total domestic value added in Mexico (Total). Nonetheless, in my view, the value added contribution from the Transport Equipment sector is the most important for total manufacturing in Mexico. This is mainly because of changes in the shares of textiles and transport equipment in the gross production of Mexico (Domestic) and Mexico (Maquila/M. Global), as described in table 5.1. In spite of the fact that the textile industry has a higher level of domestic value added in its total output than the transport sector, the textile industry has been experiencing a continuous decline in its share in the total output in each segment of the Mexican industry over time. Therefore, the opportunities for Mexico to pursue a process of upgrading (a higher level of domestic value added content) are primarily to be found in the transport sector.

We can now indicate how the effects from the increasing globalization of production express themselves in the structure of value added contributions for Mexico (total economy). On the one hand, the steady decline in the sourcing of intermediate inputs from US/Canada producers in the three most important manufacturing sectors in Mexico (i.e. Textiles, electrical and optical equipment and transport) resulted in a decline of the US/Canada value added share that can be observed at all three levels of analysis (Domestic, Maq./M.Global and, total). This decline offered opportunities for an increase in the value added share of foreign and domestic producers, that were differently exploited, depending on the sector in question. East Asian producers gained significant value added shares in the Electronic and optical equipment production in Mexico (Domestic) and even more so in Mexico (Maq./M. Global), where they now account for the largest share.[36] This increase in electronics is the main source of the increasing East Asian value added share observed at the aggregate level in the total production of Mexico (total economy). On the other hand, firms in Mexico (Domestic) and Mexico (Maq./M. Global) have succeeded in increasing their value added share in the transport equipment and textile sectors. The increases in those two manufacturing sectors, however, have not been sufficient to achieve higher levels of domestic value added shares in the final manufacturing output of Mexico (Total). In the period studied, the total domestic value added share in Mexico (Total) has not changed much. There has been a minor decrease from 62% in 1998 to 61.5% in 2011.

[36] The manufacturing subsectors within the Electrical and Optical equipment sector that do not enjoy an important modularity in their production (ovens, fridges, heaters) were less likely to reallocate their production in East Asian and opted for Mexico instead. But, the sector as a whole did increase its share in value added contributions.

5.8 Concluding Remarks.

Mexican manufacturing is composed of two sets of firms: firms primarily producing for foreign markets (Maquiladora/ M. Global) and firms primarily producing for the domestic market (Domestic manufacturing of Mexico). This chapter tries to analyze how each component of the Mexican manufacturing was affected by the increasing globalization of manufacturing production. Moreover, our research tries to identify which countries and regions from the World economy succeed in capturing most of the value added embodied in Mexican exports, as well as the extent to which Mexico itself profits from its exports.

Our value added calculations confirm that in the context of increasing globalization of production, manufacturing firms in Mexico operate under local, regional and global value chains. Firms mostly producing for the domestic market (those in Mexico-Domestic) operate in the context of local value chains with most of the value being added by Mexico (Domestic). Firms that produce for foreign markets (those in the Maquiladora industry) participate in local, regional and global value chains depending on the manufacturing sector. Thus, in order to identify the country or region that captures the highest value added contribution in the final output produced by Maquiladora/M. Global we need to analyze the conditions and factors that affect the nature of value added contributions. Those conditions include the type of good being produced, trade and tariff incentives, as well as the competitive advantages of the Mexican economy.

The pattern where firms in Mexico (Domestic) participate in local value chains and, firms in Mexico (Maquiladora/M. Global) participate in both local and regional or global value chains is the result of the new pattern of specialization of export producers since the beginning of the new millennium. Our results indicate that during the 1990s the total manufacturing production in Mexico was only local and regional. Mexico (Domestic) captured most of the value added embodied in its own final output, while the US captured most of the value added embodied in Maquiladora final output. The implementation of NAFTA, significant decreases in transport and communication costs and the emergence of more efficient producers in East Asia induced Maquiladora firms to specialize in manufacturing activities where Mexico offered the greatest competitive advantages, scaling down production of goods in which Mexico could not withstand the fierce international competition (textiles). The increasing globalization of production did not induce a new pattern of specialization for the firms in Mexico (Domestic), because those firms were not subject to significant competitive pressures (price, high quality standards, etc.) from low cost producers in supplying the domestic market.

In order to achieve success in the new patterns of specialization, maquiladora firms had to modify their sourcing behavior drastically. This resulted in a dramatic decline of imports of intermediate goods from the US. By 2005, maquiladora firms sourced most of their intermediate goods in the electronic industry from East Asia (China) and in the case of the transport equipment sector from Mexico. In some other manufacturing sectors, they continue to source their inputs from the US. Thus, Maquiladora firms now belong to local, regional as well as global value chains depending on the type of good being produced.

In my view, this pattern where maquiladora firms opt for global value chains in the electronic industry and for regional value chains in the transport industry (and in other manufacturing sectors) is a reflection of reallocation decisions by foreign (US) producers supplying intermediate inputs to the maquiladora industry. US producers who used to supply intermediate goods to maquiladora firms during the 1990s, reallocated their production either to East Asia (China) or to Mexico during the 2000s, in order to continue supplying intermediate goods to maquiladora firms. Those reallocation decisions were made considering trade and tariff incentives as well as the competitive advantages offered by each country in a particular manufacturing sector.

Our research also indicates that the pursuit of industrial upgrading in the context of this new pattern of specialization will remain a challenging task. The case of the transport equipment sector highlights to the fact that trade and tax incentives are only a necessary condition for higher levels of domestic value added content, not a sufficient one. Further regional cooperation and regulation is required between the neighboring countries that participate in the production of the final goods. Here, we are referring to the regional cooperation between the governments of Mexico and the United States, when signing the Bilateral Aviation Safety Agreement in 2007. This agreement recognizes the existence of North American production in the aerospace industry and was signed both in the interest of American firms producing in Mexico and in the interest of Mexico in acquiring technological capabilities from its neighbor. In my view, this agreement combined with tax incentives and NAFTA benefits is one of the main reasons behind the increase in the domestic value added contribution from Mexico in the transport equipment sector. This kind of regional value chain cooperation should be taken into account as a policy option for less developed economies to benefit from the increasing globalization of production.

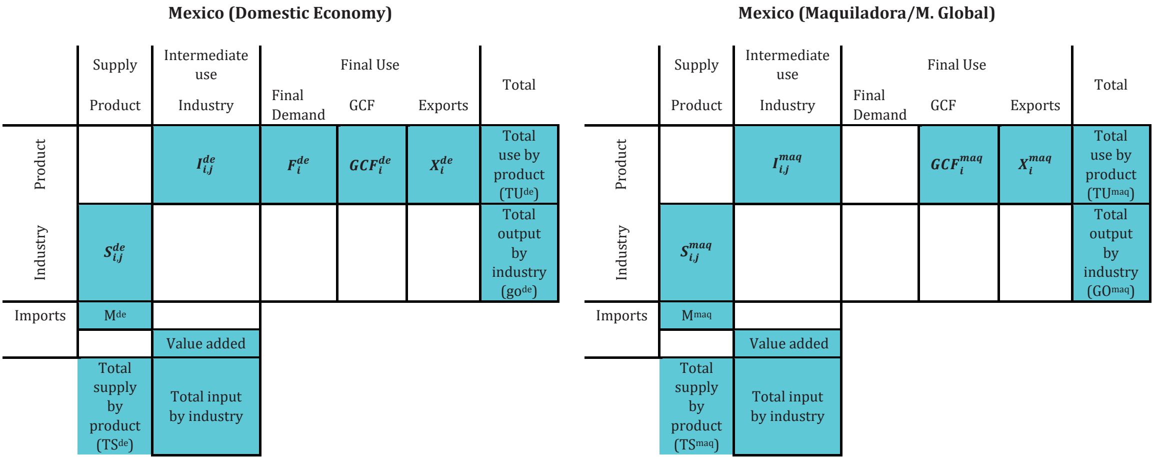
Finally, it is important to note that in terms of value added creation manufacturing production in Mexico still benefiting more from the production for its domestic market, production for export markets. This is the case in spite of the increasing globalization of production, the new patterns of specialization in the production of Mexican exports and the drastic changes in the sourcing behavior of maquiladora firms that participate in local, regional and global value chains. During the period studied in this paper, the contribution of domestic inputs in creating value added in Mexico (Domestic) was much larger than that in Mexico (Maquiladora). This is true even if we consider the increasing domestic value added content of from maquiladora firms in the transport sector. As long as, Mexico (Domestic) has much stronger linkages with the rest of the domestic economy, the scope for maquiladora to induce industrial upgrading remains limited.

Appendix A5.1.

A5.1.1 Supply and Use tables for Mexico (Domestic) and Mexico (Maquiladora/ Manufactura Global).

The first step taken by our research was to define the set-up for the supply and use tables of maquiladora/manufactura global and domestic economy of Mexico. This set up is presented in figure A5.1.

Figure A5.1: Supply and Use Tables for Mexico (Domestic Economy) and Mexico (Maquiladora/M. Global).



Notes: (de) refers to Domestic Economy and (maq) refers to Maquilladora/M. Global

Let S denote supply and M imports, subscripts i and j denote products and industries respectively. Superscript (de) stands for domestic economy of Mexico and (maq) indicate maquiladora/manufactura global. Then, total supply (TS) for each product (i) will be given by the summation of supply and imports as follows;

$$TS_i^{de} = \sum_j S_{i,j}^{de} + M_i^{de} \quad (5.1.1)$$

$$TS_i^{maq} = \sum_j S_{i,j}^{maq} + M_i^{maq} \quad (5.1.2)$$

Total use (TU) should be determined by the summation of final demand (F), gross capital formation (GCF), exports (X) and intermediate use (I). This identity will only hold for the domestic economy of Mexico. In the case of the maquiladora, total use will not consider the concept of final demand given that this industry does not consume final goods. Therefore;

$$TU_i^{de} = \sum_j I_{i,j}^{de} + F_i^{de} + GCF_i^{de} + X_i^{de} \quad (5.2.1)$$

$$TU_i^{maq} = \sum_j I_{i,j}^{maq} + GCF_i^{maq} + X_i^{maq} \quad (5.2.2)$$

Then, the identity of supply and use for each concept will be given for the domestic economy as follows

$$\sum_j S_{i,j}^{de} + M_i^{de} = \sum_j I_{i,j}^{de} + F_i^{de} + GCF_i^{de} + X_i^{de} \quad (5.3.1)$$

And for the maquiladora;

$$\sum_j S_{i,j}^{maq} + M_i^{maq} = \sum_j I_{i,j}^{maq} + GCF_i^{maq} + X_i^{maq} \quad (5.3.2)$$

The second accounting identity will be written as follows:

$$\sum_j TS_{i,j}^{de} = VA_j^{de} + \sum I_{i,j}^{de} \quad \forall j \quad (5.4.1) \text{ for the domestic economy}$$

$$\sum_j TS_{i,j}^{maq} = VA_j^{maq} + \sum I_{i,j}^{maq} \quad \forall j \quad (5.4.2) \text{ for the maquiladora/m. global}$$

This identity indicates that for each industry the total value of output (at the left hand side) is equal to the total value of inputs (right hand side). The latter is given by the sum of value added (VA) and intermediate use of products.

A5.1.2. International Supply and Use tables for Mexico (Domestic) Mexico (Maquiladora/M. Global)

With this information in mind, we proceed to calculate the international supply and use tables. An international use table is an extension of the national use table. The main difference with respect to the national use table is that the international use table explicitly indicates the use of each product by country of origin. Therefore, in order to continue a split must be made between the products that were imported and those that were domestically produced. Equations (5.5.1), (5.5.2) (5.6.1) and (5.7.1) indicate the intermediate consumption, final demand and gross capital formation for each of the two components of the Mexican economy respectively. The first superscript (de/maq) indicates the component of the Mexican economy, while the second superscript (dom/m) indicates domestic or imported origin respectively. For instance, $I_i^{de\ dom}$ indicates the domestic intermediate consumption by the domestic economy of Mexico, and $I_i^{de\ m}$ stands for the imported intermediate consumption by the domestic economy of Mexico. Thus;

$$I_{i,j}^{de} = I_{i,j}^{de\ dom} + I_{i,j}^{de\ m} \quad \forall i,j \quad (5.5.1)$$
$$I_{i,j}^{maq} = I_{i,j}^{maq\ dom} + I_{i,j}^{maq\ m} \quad \forall i,j \quad (5.5.2)$$

$$F_i^{de} = F_i^{de\ dom} + F_i^{de\ m} \quad \forall i \quad (5.6.1)$$

$$GCF_i^{de} = GCF_i^{de\ dom} + GCF_i^{de\ m} \quad \forall i \quad (5.7.1)$$
$$GCF_i^{maq} = GCF_i^{maq\ m} \quad \forall i \quad (5.7.2)$$

In this context, equation (5.81 and 5.8.2) show the supply for the domestic economy and for the maquiladora industry, respectively. As can be seen, the supply of the domestic economy contains the domestic intermediate goods produced by the domestic economy and delivered to the maquiladora ($I_{i,j}^{maq\ dom}$). Similarly, the supply of the maquiladora equals the total exports from this industry as all the production is to be exported.

$$\sum_j S_{i,j}^{de} = \sum_j I_{i,j}^{de\ dom} + \sum_j I_{i,j}^{maq\ dom} + F_i^{de\ dom} + GCF_i^{de\ dom} + X_i^{de} \quad \forall i,j \quad (5.8.1)$$
$$\sum_j S_{i,j}^{maq} = X_{i,j}^{maq} \quad \forall i,j \quad (5.8.2)$$

Finally, we also split the total imports from each component of the Mexican economy as follows:

$$M_{i,j}^{de} = I_{i,j}^{de\ m} + F_i^{de\ m} + GCF_i^{de\ m} \quad \forall i,j \quad (5.9.1)$$
$$M_{i,j}^{maq} = I_{i,j}^{maq\ m} + GCF_i^{maq\ m} \quad \forall i,j \quad (5.9.2)$$

On the basis of this information, figure A5.2 presents a set up for the international supply and use tables for Mexico (Domestic), Mexico (Maquiladora/M. Global). Here, all the information presented in previous equation is allocated according to their use (intermediate or final) and according to their origin (domestic or imported by country of origin).

Figure A5.2: International SUT for Mexico (Domestic), Mexico (Maquiladora/M. Global).

Mexico (Domestic Economy)

		Supply	Intermediate use	Final Use			Total
		Product	Industry	Final Demand	GCF	Exports	
Country A	Product		$I_{i,j}^{de\ m(A)}$	$F_i^{de\ m(A)}$	$GCF_i^{de\ m(A)}$		Total use of imported products delivered by A
Mexico (Domestic Economy)	Product		$I_{i,j}^{de\ dom}$	$F_i^{de\ dom}$	$GCF_i^{de\ dom}$	X_i^{de}	Total use of domestic products
Mexico (Maquiladora/ M. Global)	Product						
Rest of the World	Product		$I_{i,j}^{de\ m(RoW)}$	$F_i^{de\ m(RoW)}$	$GCF_i^{de\ m(RoW)}$		Total use of imported products delivered by RoW
Mexico (Domestic Economy)	Industry	$S_{i,j}^{de}$					TU^{de}
	Rest of the World	M_j^{de}					
			Value added (VA)				
		TS^{de}	Output				

Mexico (Maquiladora/M.Global)

		Supply	Intermediate use	Final Use			Total
		Product	Industry	Final Demand	GCF	Exports	
Country A	Product		$I_{i,j}^{maq\ m(A)}$		$GCF_i^{maq\ m(A)}$		Total use of imported products delivered by A
Mexico (Domestic Economy)	Product		$I_{i,j}^{maq\ dom}$				Total use of products delivered to Maq/M.Global
Mexico (Maquiladora/ M. Global)	Product					X_i^{maq}	X_i^{maq}
Rest of the World	Product		$I_{i,j}^{maq\ m(RoW)}$		$GCF_i^{maq\ m(RoW)}$		Total use of imported products delivered by RoW
Mexico (Maq./M.Global)	Industry	$S_{i,j}^{maq}$					TU^{maq}
	Rest of the World	M_j^{maq}					
			Value added (VA)				
		TS^{maq}	Output				

Notes: the first superscript indicates the main component being studied (Domestic Economy or Maq/M. Global) and the second superscript indicates origin from goods (domestic or imported). For instance $I_{i,j}^{mqq\ m(RoW)}$ indicates intermediate imports delivered by the Rest of the World to the maquiladora/m. global.

In order to construct those international use tables, we need to break down imports by country of origin and by use category. Following Timmer et al. (2014), this step requires international trade statistics that are to be benchmarked with the official data from the national accounting system by which the national SUTS were built. That step was followed in order to ensure consistency between the data in the national and international use tables.

Formally, let $m_{i,k}^{l}$ indicate the share of use categories $\boldsymbol{l}$ (intermediate, final consumption or investment) in imports of product $\boldsymbol{I}$ delivered by a particular country $\boldsymbol{k}$ to a component of the Mexican economy $\boldsymbol{\alpha}$ (domestic economy or maquiladora/m.global) defined as follows.

$$m_{i,k}^{\alpha\,l} = \frac{\widetilde{M}_{i,k}^{\alpha\,l}}{\widetilde{M}_{i}^{\alpha}} \text{ such that } \sum_k \sum_l m_{i,k}^{\alpha\,l} = 1$$

where $\widetilde{M}_{i,k}^{\alpha\,l}$ is the total value from all 6-digit products that are classified by use category $\boldsymbol{l}$ and WIOD product group $\boldsymbol{i}$ imported from country $\boldsymbol{k}$ (and delivered to component $\boldsymbol{\alpha}$) , and $\widetilde{M}_{i}^{\alpha}$ the total value of WIOD product group $\boldsymbol{i}$ imported by component $\boldsymbol{\alpha}$ of the Mexican economy. These shares have to be derived from the bilateral trade statistics and applied to the total imports of product $\boldsymbol{I}$ by component $\boldsymbol{\alpha}$ of the Mexican economy as given in the SUT time series to derive their imported use categories. In this context $I_{i,k}^{\alpha\,m}$ is the amount of product group $\boldsymbol{i}$ imported from country $\boldsymbol{k}$ and used as intermediate by industry $\boldsymbol{j}$ in component $\boldsymbol{\alpha}$ of the Mexican economy.

$$I_{i,k}^{\alpha\,m} = m_{i,k}^{\alpha\,I} M_{i}^{\alpha} \frac{I_{i,j}^{\alpha}}{I_{i}^{\alpha}} \quad \forall j$$

Where $I_{i}^{\alpha} = \sum_j I_{i,j}^{\alpha} \ \ \forall i$ such that $\frac{I_{i,j}^{\alpha}}{I_{i}^{\alpha}}$ is the share of intermediates of product $\boldsymbol{i}$ used by industry $\boldsymbol{j}$ in each component $\boldsymbol{\alpha}$ of the Mexican economy.

By definition, it is only the domestic economy of Mexico that demands goods for final demand and for gross capital formation. Therefore, our research did not modify that data original reported by WIOD on their international use tables for the total economy of Mexico. We simply transfer them to our international use tables and relabeled them as the final demand and gross capital formation for the Domestic economy of Mexico. Finally, in the case of the imported gross capital formation for the Maquiladora and M. Global, we obtained that data from our trade data statistics after classifying its bilateral import by its corresponding BEC category. Afterwards, we simply allocate those gross capital imports classified by product category in the columns for gross capital formation (there will be no changes in inventories for the Maquiladora/M. Global). This is because of the fact that official imported use table for the maquiladora does not provide gross capital categories so we cannot benchmarked them.

A5.1.3 .International SUT for the Rest of WIOD Countries Including Mexico (Domestic) and Mexico (Maquiladora/Manufactura Global).

Figure A5.3 presents the set up for an international use table for the rest of WIOD countries where Mexico (Domestic) and Mexico (Maquiladora/M. Global) are included. Here, we assume that the domestic economy of Mexico delivers goods for intermediate use, final demand and gross capital formation. On the other hand, it is assumed that the maquiladora/m. global only delivers goods for final demand. Therefore, our research decided that we only needed to calculate the columns for final demand delivered by the domestic economy of Mexico ($F_i^{a\ m(de)}$) and by Maquiladora/M. Global ($F_i^{a\ m(maq)}$). This means that the data for intermediate goods and gross capital formation demanded by WIOD countries and delivered by Mexico (as initially reported by WIOD) will remain unaltered. We will simply re-label them as the intermediate goods and gross capital formation delivered by the domestic economy of Mexico.

Figure A5.3: International SUT for WIOD countries including Mexico (Domestic), Mexico (Maquiladora/M. Global).

WIOD Countries (Country A)

		Supply	Intermediate use	Final Use			Total
		Product	Industry	Final Demand	GCF	Exports	
Country A	Product		$I_{i,j}^{a\ dom}$	$F_i^{a\ dom}$	$GCF_i^{a\ dom}$	X_i^a	Total use of domestic products
Mexico (Domestic Economy)	Product		$I_{i,j}^{a\ m(de)}$	$F_i^{a\ m(de)}$	$GCF_i^{a\ m(de)}$		Total use of imported products delivered by Mexico (Domestic)
Mexico (Maquiladora)	Product			$F_i^{a\ m(maq)}$			Total use of imported products delivered by Maquiladora
Rest of the World	Product		$I_{i,j}^{a\ m(RoW)}$	$F_i^{a\ m(RoW)}$	$GCF_i^{a\ m(RoW)}$		Total use of imported products delivered by RoW
Country A	Industry	$S_{i,j}^a$					TU^a
	Rest of the World	M_j^a					
			Value added (VA)				
		TS^a	Output				

Notes: the first superscript indicates the main country being studied and the second superscript indicates origin from goods (domestic or imported). For instance $I_{i,j}^{a\ m(RoW)}$ indicates intermediate imports delivered by the Rest of the World to country A.

In calculating the final demand deliveries by Mexico (Domestic) to the rest of WIOD countries, ideally we would have to find the difference between the data originally provided by WIOD and our specific data for Mexico (Maq/M. Global). This is because, in principle, the data originally provided by WIOD in the international use tables for the rest of WIOD countries contains both Maquila and Domestic economy deliveries. In doing that, however, we found that our Maq/M. Global export data was in many case much larger than the one originally provided in WIOD for the case of Mexico. This issue is explained by the fact that (when constructing those tables) WIOD relied on the imports reported by each country and that our data for Maq/M. Global in this specific international use tables needs to rely on the data for exports. Therefore, in order to exclude negative values and ensure the consistency of our results, our research will also assume that the final demand deliveries originally reported by WIOD for the case of the total economy of Mexico correspond to the those deliveries by the Domestic Economy of Mexico.

Relying in Maq/M. Global bilateral exports is a crucial step in constructing international SUTs like the one in figure A5.3. This is because there is no other alternative way by which we can indicate how the Maq/M. Global gross production in each of the WIOD countries. Furthermore, we are confident that aforementioned assumption will not severely bias our results given that the bulk of manufacturing exports from Maq/M. Global go to the United States.

Formally, let $x_{i,k}^{maq}$ indicate the share of final demand use in exports of product ***i*** delivered by Maq/M. Global to particular country ***k*** defined as follows.

$$x_{i,k}^{maq} = \frac{\tilde{X}_{i,k}^{maq}}{\tilde{X}_{i}^{maq}} \text{ such that } \sum_k x_{i,k}^{maq} = 1$$

where $\tilde{X}_{i,k}^{maq}$ is the total value from all 6-digit products that are classified by product group ***i*** exported by Maq/M. Global and delivered to country ***k***, and $\tilde{X}_{i}^{maq}$ the total value of WIOD product group ***i*** exported by Maq/M Global. These shares have to be derived from the bilateral trade statistics and applied to the total exports of product ***i*** from Maq/M. Global. Finally, that value is applied to the final demand share of use category from the rest of WIOD countries (as given in their SUT time series) to derive the necessary imported final use categories. In this context $F_i^{k\,m(maq)}$ is the amount of product group ***i*** imported from Maq/M. Global and used as final demand in country k

$$F_i^{k\,m(maq)} = x_{i,k}^{maq}\, X_i^{maq}\, \frac{FC_{i,f}^{k}}{FC_i^{k}}$$

Where $\frac{FC_{i,f}^{k}}{FC_i^{k}}$ is the share of final demand goods by use categories in country k.

Once we had all the international SUT for Mexico (Domestic), Mexico (Maquiladora/Manufactura Global) and the rest of WIOD countries, we proceeded to calculate the WIOT which is presented in Figure A.1.4. Following WIOD, we transformed all the international SUT into world input-output structure by means of the "fixed product-sales structure" assumption. This assumption states that each product has its own specific sales structure irrespective of the industry where it is produced. Sales structure here refers to the proportions of the output of the product in which it is sold to the respective intermediate and final users.

Figure A5.4: Final Set up of World Input-Output Table Including Mexico (Domestic) and Mexico (Maquiladora/M.Global)

		Country A	Mexico (Domestic Economy)	Mexico (Maquiladora/ M. Global)	Rest of the World	Country A	Mexico (Domestic Economy)	Mexico (Maquiladora/ M. Global)	Rest of the World	Country A	Mexico (Domestic Economy)	Mexico (Maquiladora/ M. Global)	Rest of the World	
		Supply	Supply	Supply	Supply	Intermediate use	Intermediate use	Intermediate use	Intermediate use	Final Use	Final Use	Final Use	Final Use	Total
		Industry	Industry	Industry	Industry	Industry	Industry	Industry	Industry					
Country A	Industry					$I_{j,j}^{a\ dom}$	$I_{j,j}^{de\ m(a)}$	$I_{j,j}^{maq\ m(a)}$	$I_{j,j}^{row\ m(a)}$	$F_j^{a\ dom}$, $GCF_j^{a\ dom}$	$F_j^{de\ m(a)}$, $GCF_j^{de\ m(a)}$	$GCF_j^{maq\ m(a)}$	$F_j^{row\ m(a)}$, $GCF_j^{row\ m(a)}$	Output in A
Mexico (Domestic)	Industry					$I_{j,j}^{a\ m(de)}$	$I_{j,j}^{de\ dom}$	$I_{j,j}^{maq\ de}$	$I_{j,j}^{row\ m(de)}$	$F_j^{a\ m(de)}$, $GCF_j^{a\ m(de)}$	$F_j^{de\ dom}$, $GCF_j^{de\ dom}$		$F_j^{row\ m(de)}$, $GCF_j^{row\ m(de)}$	Output in Mexico (DE)
Mexico (Maq/M.Glob)	Industry									$F_j^{a\ m(maq)}$			$F_j^{row\ m(maq)}$	Output in Mexico (MAQ)
Rest of the World (RoW)	Industry					$I_{j,j}^{a\ m(RoW)}$	$I_{j,j}^{de\ m(RoW)}$	$I_{j,j}^{maq\ m(RoW)}$	$I_{j,j}^{row\ dom}$	$F_j^{a\ m(RoW)}$, $GCF_j^{a\ m(Row)}$	$F_j^{de\ m(row)}$, $GCF_j^{de\ m(row)}$	$GCF_j^{maq\ m(row)}$	$F_j^{row\ dom}$, $GCF_j^{row\ dom}$	Output in RoW
Country A	Industry	Domestic Supply												
Mexico (Domestic)	Industry		Domestic Supply											
Mexico (Maq/M.Glob)	Industry			Domestic Supply										
Rest of the World (RoW)	Industry				Domestic Supply									
Total		Imports	Imports	Imports	Imports									
		Total Supply	Total Supply	Total Supply	Total Supply									
						Value Added	Value Added	Value Added	Value Added					
						Output in A	Output in Mexico (DE)	Output in Mexico (MAQ)	Output in RoW					

Appendix A5.2.

Share of Regional Value Added Content Embodied in Final Manufacturing Output Produced by Mexico (Domestic). All Manufacturing Sectors.

Food, Beverages and Tobacco

Share of regional value added embodied in final manufacturing output

Region	Domestic Economy of Mexico													
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
USA and Canada	8.5%	7.7%	6.4%	7.2%	6.3%	7.0%	8.0%	8.4%	8.2%	9.3%	10.4%	9.7%	10.6%	12.5%
East Asia	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.7%	0.7%
Europe	2.8%	3.2%	3.7%	2.4%	2.2%	2.4%	1.6%	1.4%	1.1%	1.4%	1.4%	1.2%	1.2%	1.4%
ROW	2.1%	1.8%	1.9%	1.8%	2.7%	2.8%	3.1%	2.4%	2.6%	2.1%	2.4%	2.4%	2.4%	2.4%
MEX (DOM)	86.2%	86.9%	87.6%	88.1%	88.4%	87.4%	86.8%	87.3%	87.6%	86.7%	85.2%	86.1%	85.2%	83.1%
Total final output	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Food, Beverages and Tobacco

Share of regional value added embodied in final manufacturing output

Region	Maquiladora									Manufactura Global				
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
USA and Canada	35.5%	31.4%	33.2%	33.6%	30.0%	32.0%	37.8%	33.0%	41.6%	49.1%	46.6%	44.4%	44.9%	44.2%
East Asia	0.8%	1.0%	0.9%	0.9%	1.1%	1.3%	1.7%	1.9%	1.8%	2.3%	2.7%	2.7%	2.9%	3.3%
Europe	1.6%	1.5%	1.6%	1.7%	2.0%	2.7%	3.1%	3.6%	2.9%	6.3%	8.5%	8.0%	7.8%	7.4%
ROW	1.5%	1.5%	1.8%	4.2%	8.2%	10.3%	12.3%	15.5%	8.2%	9.6%	12.4%	14.6%	15.0%	15.7%
MEX (DOM)	37.8%	40.7%	40.9%	36.4%	33.4%	30.7%	24.4%	24.6%	28.9%	19.1%	16.3%	18.0%	14.9%	14.1%
MEX (MAQ/ Manuf Global)	22.9%	23.9%	21.6%	23.3%	25.3%	23.0%	20.8%	21.4%	16.6%	13.7%	13.4%	12.3%	14.5%	15.3%
Total final output	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Textiles and Textile Products

Share of regional value added embodied in final manufacturing output

Region	Domestic Economy of Mexico													
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
USA and Canada	17.0%	18.0%	18.6%	16.8%	16.0%	15.5%	15.5%	13.9%	13.0%	13.6%	11.5%	11.5%	11.7%	12.4%
East Asia	2.8%	4.0%	3.8%	3.5%	3.6%	3.6%	4.1%	4.5%	3.9%	3.2%	3.3%	3.5%	3.9%	4.0%
Europe	2.9%	3.0%	2.7%	2.8%	3.2%	3.4%	3.3%	3.4%	3.4%	2.7%	2.6%	2.1%	2.1%	2.2%
ROW	3.2%	2.8%	2.9%	2.8%	2.8%	3.7%	3.4%	3.7%	3.4%	3.0%	3.1%	2.7%	2.8%	3.0%
MEX (DOM)	74.1%	72.2%	71.9%	74.1%	74.4%	73.7%	73.7%	74.6%	76.2%	77.5%	79.5%	80.1%	79.5%	78.5%
Total final output	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Textiles and Textile Products

Share of regional value added embodied in final manufacturing output

Region	Maquiladora									Manufactura Global				
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
USA and Canada	64.4%	63.0%	57.8%	55.7%	54.9%	55.9%	55.6%	52.0%	51.6%	46.8%	40.1%	43.8%	42.6%	39.0%
East Asia	2.7%	2.7%	4.1%	3.1%	3.8%	4.2%	5.2%	7.1%	7.7%	8.5%	9.1%	11.2%	13.3%	12.3%
Europe	3.0%	2.9%	3.0%	3.2%	3.0%	3.6%	3.6%	3.8%	4.3%	6.6%	6.5%	6.0%	6.3%	6.3%
ROW	1.9%	2.2%	3.4%	2.7%	2.6%	3.5%	3.5%	4.3%	4.6%	6.8%	7.8%	8.3%	8.9%	8.8%
MEX (DOM)	9.4%	10.0%	11.6%	12.3%	13.7%	11.9%	11.3%	11.4%	11.7%	12.5%	12.2%	13.4%	11.2%	12.3%
MEX (MAQ/ Manuf Global)	18.7%	19.2%	20.2%	23.1%	21.9%	20.9%	20.8%	21.3%	20.2%	18.9%	24.3%	17.2%	17.7%	21.3%
Total final output	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Leather, Leather and Footwear

Share of regional value added embodied in final manufacturing output

Region	Domestic Economy of Mexico													
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
USA and Canada	10.0%	9.1%	8.0%	7.7%	6.5%	9.1%	10.6%	8.4%	6.7%	6.0%	5.3%	4.2%	5.0%	5.8%
East Asia	0.5%	0.7%	0.5%	0.4%	0.5%	0.5%	0.6%	0.7%	0.8%	0.8%	0.7%	0.5%	0.7%	0.8%
Europe	1.9%	1.7%	1.7%	1.2%	1.3%	1.5%	1.5%	1.5%	1.5%	1.7%	1.9%	1.6%	1.7%	2.3%
ROW	1.6%	1.8%	2.1%	1.8%	1.8%	2.1%	2.8%	3.7%	4.4%	4.4%	4.4%	2.5%	3.2%	4.4%
MEX (DOM)	86.1%	86.8%	87.7%	88.8%	90.0%	86.9%	84.5%	85.7%	86.5%	87.1%	87.8%	91.1%	89.4%	86.7%
Total final output	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Leather, Leather and Footwear

Share of regional value added embodied in final manufacturing output

Region	Maquiladora									Manufactura Global				
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
USA and Canada	58.4%	59.0%	57.3%	46.4%	43.3%	44.3%	46.8%	39.3%	36.7%	31.7%	29.6%	33.0%	40.0%	33.0%
East Asia	4.9%	4.3%	4.3%	4.3%	3.6%	3.5%	3.5%	4.5%	6.0%	6.3%	4.9%	4.9%	6.7%	5.8%
Europe	4.9%	4.7%	3.6%	7.4%	10.1%	10.2%	9.6%	9.1%	10.5%	8.5%	9.5%	7.5%	5.8%	4.6%
ROW	6.4%	6.4%	7.1%	12.8%	15.5%	13.4%	10.2%	16.1%	16.9%	18.6%	21.9%	20.1%	20.4%	25.6%
MEX (DOM)	8.0%	8.1%	8.6%	8.0%	9.5%	10.4%	12.0%	12.2%	12.6%	17.0%	17.1%	14.9%	12.8%	12.9%
MEX (MAQ/ Manuf Global)	17.3%	17.5%	19.0%	21.2%	18.0%	18.3%	18.0%	18.7%	17.5%	17.9%	17.0%	19.6%	14.4%	18.2%
Total final output	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Pulp, Paper, Paper , Printing and Publishing

Share of regional value added embodied in final manufacturing output

Region	Domestic Economy of Mexico													
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
USA and Canada	8.1%	9.6%	9.7%	8.5%	7.4%	6.8%	6.7%	5.8%	5.8%	9.2%	8.5%	9.6%	9.7%	9.7%
East Asia	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.6%	0.5%	0.6%	0.7%	0.8%	0.9%	1.0%
Europe	1.2%	1.3%	1.3%	1.3%	1.5%	1.7%	1.6%	1.6%	1.5%	1.7%	1.7%	1.6%	1.8%	1.7%
ROW	0.5%	0.6%	0.8%	0.8%	0.8%	1.4%	0.8%	1.4%	0.9%	1.0%	1.1%	1.0%	1.1%	1.1%
MEX (DOM)	89.8%	87.9%	87.7%	89.0%	89.8%	89.7%	90.3%	90.7%	91.3%	87.4%	88.0%	87.0%	86.5%	86.5%
Total final output	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Pulp, Paper, Paper , Printing and Publishing

Share of regional value added embodied in final manufacturing output

Region	Maquiladora									Manufactura Global				
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
USA and Canada	66.0%	59.3%	56.6%	53.0%	52.9%	52.6%	56.1%	57.0%	57.4%	48.1%	46.1%	46.8%	46.8%	43.7%
East Asia	2.0%	2.0%	2.1%	3.5%	4.9%	5.3%	4.0%	4.4%	4.2%	4.6%	4.9%	4.9%	5.7%	6.5%
Europe	2.6%	2.3%	2.5%	2.4%	2.6%	2.8%	3.0%	3.0%	3.2%	9.5%	10.5%	9.1%	9.6%	9.4%
ROW	1.5%	1.6%	2.0%	2.1%	2.3%	2.8%	2.5%	2.9%	3.1%	5.9%	6.5%	5.3%	6.0%	6.3%
MEX (DOM)	10.0%	12.0%	14.3%	14.2%	12.4%	13.0%	12.3%	12.8%	13.8%	15.9%	12.9%	16.3%	16.2%	17.2%
MEX (MAQ/ Manuf Global)	18.0%	22.7%	22.5%	24.9%	25.0%	23.6%	22.0%	19.9%	18.2%	16.0%	19.1%	17.5%	15.6%	16.9%
Total final output	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chemicals and Chemical Products

Share of regional value added embodied in final manufacturing output

Region	Domestic Economy of Mexico													
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
USA and Canada	8.2%	7.4%	8.7%	7.6%	7.1%	8.3%	8.6%	7.8%	8.8%	7.0%	7.3%	7.6%	6.7%	6.3%
East Asia	0.8%	0.8%	0.8%	0.8%	0.8%	0.9%	0.9%	1.1%	1.1%	1.0%	1.1%	1.1%	1.1%	1.1%
Europe	2.5%	2.1%	2.5%	2.5%	2.6%	3.8%	3.2%	3.0%	3.0%	2.2%	2.5%	2.3%	2.1%	1.9%
ROW	1.8%	2.5%	1.9%	1.6%	1.6%	1.2%	2.0%	5.2%	2.2%	1.7%	2.1%	1.9%	1.9%	1.8%
MEX (DOM)	86.7%	87.3%	86.1%	87.5%	87.9%	85.8%	85.3%	83.0%	84.9%	88.1%	86.9%	87.1%	88.1%	89.0%
Total final output	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chemicals and Chemical Products

Share of regional value added embodied in final manufacturing output

Region	Maquiladora									Manufactura Global				
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
USA and Canada	45.2%	44.1%	47.1%	50.7%	38.7%	40.5%	38.0%	37.4%	33.4%	24.3%	23.4%	25.8%	25.1%	25.0%
East Asia	2.6%	2.4%	3.3%	6.9%	9.6%	2.7%	6.8%	6.2%	5.2%	4.7%	5.1%	4.9%	5.3%	5.1%
Europe	3.2%	2.8%	3.1%	3.4%	2.9%	3.0%	5.4%	5.3%	8.4%	18.7%	19.5%	18.2%	15.4%	14.2%
ROW	1.8%	2.3%	3.3%	3.6%	2.8%	3.1%	4.1%	5.3%	6.1%	9.9%	10.3%	9.8%	10.0%	10.0%
MEX (DOM)	28.4%	28.0%	24.3%	17.7%	26.5%	29.2%	24.5%	24.3%	24.8%	24.9%	24.8%	24.3%	24.9%	25.7%
MEX (MAQ/ Manuf Global)	18.8%	20.5%	18.9%	17.8%	19.5%	21.6%	21.3%	21.5%	22.2%	17.4%	16.9%	16.9%	19.2%	20.0%
Total final output	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Rubber and Plastics

Share of regional value added embodied in final manufacturing output

Region	Domestic Economy of Mexico													
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
USA and Canada	13.0%	12.2%	11.5%	11.4%	10.1%	10.7%	9.0%	8.1%	7.4%	9.4%	8.2%	9.1%	9.0%	10.5%
East Asia	1.1%	1.2%	1.1%	1.1%	1.1%	1.1%	1.0%	1.1%	1.1%	1.4%	1.4%	1.6%	1.9%	2.3%
Europe	2.1%	1.9%	1.9%	2.0%	1.9%	2.3%	1.8%	1.8%	1.7%	1.8%	1.7%	1.7%	1.7%	1.9%
ROW	1.4%	1.1%	1.4%	1.5%	1.2%	1.4%	1.4%	1.8%	1.5%	1.7%	1.7%	1.5%	1.7%	2.1%
MEX (DOM)	82.5%	83.6%	84.1%	84.0%	85.8%	84.5%	86.7%	87.1%	88.3%	85.7%	86.9%	86.1%	85.8%	83.2%
Total final output	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Rubber and Plastics

Share of regional value added embodied in final manufacturing output

Region	Maquiladora									Manufactura Global				
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
USA and Canada	56.3%	55.7%	53.7%	50.3%	54.0%	51.5%	49.0%	47.1%	46.1%	47.9%	44.6%	44.7%	48.6%	45.3%
East Asia	2.8%	3.2%	3.3%	4.4%	5.4%	6.2%	7.9%	8.5%	8.2%	9.7%	10.4%	10.9%	10.9%	12.8%
Europe	2.8%	2.9%	3.1%	3.0%	3.3%	3.5%	4.2%	4.8%	4.6%	7.4%	8.0%	7.3%	7.4%	8.3%
ROW	1.8%	2.2%	2.5%	2.6%	2.7%	3.1%	3.7%	4.2%	4.3%	5.3%	6.1%	5.2%	5.7%	7.1%
MEX (DOM)	15.0%	15.1%	16.5%	18.3%	15.3%	16.5%	16.8%	16.8%	17.4%	15.7%	15.0%	15.8%	14.3%	13.4%
MEX (MAQ/ Manuf Global)	21.3%	20.9%	20.8%	21.4%	19.2%	19.2%	18.4%	18.6%	19.2%	14.0%	15.9%	16.0%	13.1%	13.1%
Total final output	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Other Non-Metallic Mineral

Share of regional value added embodied in final manufacturing output

Region	Domestic Economy of Mexico													
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
USA and Canada	6.5%	6.4%	6.8%	5.6%	5.3%	5.5%	5.5%	5.2%	5.6%	5.6%	5.2%	4.9%	4.9%	5.0%
East Asia	0.5%	0.5%	0.5%	0.5%	0.6%	0.7%	0.8%	1.0%	1.0%	1.1%	1.4%	1.3%	1.4%	1.7%
Europe	1.9%	1.8%	1.7%	1.8%	1.9%	2.3%	2.1%	2.3%	2.0%	1.9%	1.9%	1.5%	1.6%	1.7%
ROW	0.8%	1.0%	0.9%	1.0%	1.1%	1.3%	1.3%	1.8%	1.2%	1.4%	1.5%	1.1%	1.2%	1.4%
MEX (DOM)	90.4%	90.3%	90.1%	91.0%	91.1%	90.3%	90.2%	89.7%	90.1%	89.9%	90.0%	91.2%	90.9%	90.2%
Total final output	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Other Non-Metallic Mineral

Share of regional value added embodied in final manufacturing output

Region	Maquiladora									Manufactura Global				
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
USA and Canada	44.6%	46.2%	46.5%	42.4%	39.4%	46.1%	41.2%	31.8%	34.5%	14.6%	18.2%	25.0%	23.3%	20.2%
East Asia	12.6%	11.3%	11.5%	11.6%	14.9%	15.8%	27.9%	36.3%	32.2%	12.1%	7.5%	5.9%	9.3%	6.5%
Europe	3.0%	3.7%	3.9%	3.8%	4.7%	4.3%	6.0%	5.6%	6.1%	4.1%	5.5%	7.0%	5.6%	5.4%
ROW	1.9%	2.9%	4.6%	4.4%	4.1%	4.1%	7.2%	8.5%	8.0%	4.2%	4.1%	4.1%	4.6%	4.3%
MEX (DOM)	17.5%	16.8%	15.1%	16.5%	15.5%	14.3%	8.3%	8.3%	9.1%	33.1%	32.3%	29.1%	28.7%	32.5%
MEX (MAQ/ Manuf Global)	20.4%	19.2%	18.4%	21.2%	21.4%	15.4%	9.3%	9.5%	10.2%	32.0%	32.4%	28.8%	28.5%	31.1%
Total final output	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Basic Metals and Fabricated Metal

Share of regional value added embodied in final manufacturing output

Region	Domestic Economy of Mexico													
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
USA and Canada	11.5%	11.1%	10.8%	9.3%	8.0%	9.2%	10.8%	10.6%	10.9%	9.7%	10.2%	8.0%	8.8%	10.8%
East Asia	1.8%	1.7%	1.8%	1.4%	1.3%	1.6%	2.2%	2.5%	2.9%	2.1%	2.5%	2.2%	2.4%	3.0%
Europe	3.6%	3.0%	2.6%	2.3%	2.3%	2.8%	3.7%	3.8%	4.0%	3.0%	3.3%	2.2%	2.2%	2.7%
ROW	3.1%	2.7%	3.0%	2.4%	2.3%	2.7%	3.8%	4.3%	5.1%	3.5%	3.8%	2.4%	2.9%	3.5%
MEX (DOM)	80.0%	81.5%	81.8%	84.6%	86.0%	83.8%	79.7%	78.8%	77.1%	81.7%	80.2%	85.2%	83.7%	80.0%
Total final output	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Basic Metals and Fabricated Metal

Share of regional value added embodied in final manufacturing output

Region	Maquiladora									Manufactura Global				
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
USA and Canada	58.3%	57.9%	58.2%	54.8%	55.5%	52.9%	48.6%	48.2%	46.9%	39.9%	36.7%	36.5%	38.2%	34.9%
East Asia	3.2%	3.3%	4.0%	5.0%	6.1%	5.9%	8.5%	9.1%	10.0%	9.7%	10.4%	11.6%	12.8%	15.2%
Europe	2.9%	2.9%	3.1%	3.1%	3.3%	3.2%	4.3%	5.0%	5.3%	7.2%	7.4%	6.5%	7.6%	7.7%
ROW	2.2%	2.6%	2.9%	3.8%	3.3%	3.7%	5.2%	5.9%	6.4%	6.3%	6.5%	5.4%	6.7%	7.1%
MEX (DOM)	16.9%	14.4%	13.8%	15.0%	14.4%	15.4%	15.7%	16.2%	17.3%	20.4%	20.6%	21.0%	16.9%	17.0%
MEX (MAQ/ Manuf Global)	16.4%	18.9%	18.0%	18.2%	17.4%	18.8%	17.6%	15.6%	14.1%	16.5%	18.3%	19.0%	17.8%	18.1%
Total final output	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Machinery, Nec

Share of regional value added embodied in final manufacturing output

Region	Domestic Economy of Mexico													
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
USA and Canada	11.1%	8.7%	9.5%	9.1%	8.3%	8.2%	9.0%	8.6%	7.8%	8.5%	7.9%	15.8%	17.6%	18.5%
East Asia	1.5%	2.2%	1.5%	1.6%	1.5%	1.4%	1.8%	1.8%	1.9%	1.3%	1.5%	2.9%	3.4%	3.7%
Europe	2.6%	1.9%	2.5%	2.4%	2.0%	2.0%	2.5%	2.5%	2.4%	2.4%	2.7%	5.3%	5.1%	5.6%
ROW	1.1%	0.8%	1.0%	1.6%	1.3%	1.3%	1.6%	1.7%	1.7%	1.5%	1.6%	2.5%	3.2%	3.4%
MEX (DOM)	83.7%	86.4%	85.4%	85.3%	86.8%	87.1%	85.2%	85.4%	86.3%	86.2%	86.3%	73.4%	70.7%	68.9%
Total final output	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Machinery, Nec

Share of regional value added embodied in final manufacturing output

Region	Maquiladora									Manufactura Global				
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
USA and Canada	67.0%	66.4%	62.7%	43.5%	31.8%	25.9%	24.1%	24.9%	26.0%	21.4%	21.7%	24.2%	24.2%	23.4%
East Asia	5.3%	6.7%	4.9%	13.9%	23.8%	27.8%	30.1%	28.0%	26.6%	19.5%	16.9%	26.2%	31.1%	29.6%
Europe	3.5%	3.2%	3.1%	4.2%	5.6%	6.0%	7.1%	7.6%	7.7%	7.8%	8.2%	9.2%	8.6%	8.7%
ROW	2.6%	3.2%	3.3%	8.6%	11.7%	12.3%	12.0%	12.8%	12.9%	9.4%	9.0%	11.8%	12.7%	12.3%
MEX (DOM)	8.1%	7.4%	10.2%	11.3%	11.3%	11.8%	11.2%	13.2%	14.5%	19.8%	20.9%	11.2%	10.1%	11.1%
MEX (MAQ/ Manuf Global)	13.4%	13.1%	15.8%	18.4%	15.8%	16.2%	15.5%	13.4%	12.4%	22.0%	23.4%	17.4%	13.3%	14.9%
Total final output	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Electrical and Optical Equipment

Share of regional value added embodied in final manufacturing output

Region	Domestic Economy of Mexico													
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
USA and Canada	35.3%	32.0%	32.5%	33.5%	27.3%	27.3%	23.3%	23.8%	24.6%	32.2%	31.4%	29.8%	29.9%	31.0%
East Asia	6.6%	11.9%	7.8%	8.1%	10.1%	10.2%	13.7%	15.7%	16.0%	11.4%	11.2%	13.0%	14.3%	14.7%
Europe	10.0%	10.1%	11.5%	10.7%	9.3%	10.6%	11.9%	11.9%	11.2%	8.4%	8.5%	7.9%	8.1%	8.3%
ROW	3.0%	2.1%	6.0%	3.6%	8.3%	8.2%	9.6%	8.0%	7.4%	6.1%	6.1%	5.9%	6.7%	6.7%
MEX (DOM)	45.2%	44.0%	42.2%	44.2%	45.0%	43.6%	41.5%	40.7%	40.8%	41.9%	42.8%	43.3%	40.9%	39.3%
Total final output	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Electrical and Optical Equipment

Share of regional value added embodied in final manufacturing output

Region	Maquiladora									Manufactura Global				
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
USA and Canada	69.6%	66.3%	65.2%	55.3%	50.3%	50.3%	40.0%	32.5%	28.1%	26.1%	25.3%	24.0%	24.3%	25.7%
East Asia	8.7%	10.0%	9.6%	15.7%	20.9%	19.9%	26.9%	31.8%	37.9%	36.3%	38.6%	41.0%	40.9%	39.2%
Europe	3.8%	3.8%	3.9%	4.3%	4.6%	5.5%	7.8%	8.3%	7.8%	8.6%	8.5%	7.2%	7.4%	7.8%
ROW	3.6%	4.1%	4.8%	5.9%	6.7%	7.5%	10.0%	11.9%	11.4%	9.8%	9.6%	9.1%	9.8%	10.6%
MEX (DOM)	5.0%	5.7%	6.1%	6.9%	6.9%	7.0%	6.6%	6.4%	6.0%	9.9%	9.6%	10.2%	9.5%	8.6%
MEX (MAQ/ Manuf Global)	9.3%	10.1%	10.5%	11.8%	10.6%	9.7%	8.7%	9.0%	8.8%	9.4%	8.3%	8.5%	8.0%	8.2%
Total final output	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Transport Equipment

Share of regional value added embodied in final manufacturing output

Region	Domestic Economy of Mexico													
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
USA and Canada	27.0%	26.9%	26.7%	25.3%	25.1%	24.1%	24.1%	22.2%	20.2%	18.8%	18.3%	15.9%	17.9%	19.0%
East Asia	2.0%	2.6%	2.9%	2.6%	2.6%	2.5%	3.3%	3.6%	5.0%	6.1%	5.8%	4.9%	7.7%	7.8%
Europe	5.1%	5.1%	5.4%	5.0%	5.2%	5.5%	5.7%	6.0%	6.2%	5.5%	5.8%	6.1%	4.3%	4.5%
ROW	1.2%	1.3%	1.8%	1.9%	2.0%	2.9%	2.6%	3.2%	2.8%	4.1%	4.3%	2.9%	2.8%	3.0%
MEX (DOM)	64.7%	64.1%	63.2%	65.1%	65.2%	64.9%	64.4%	65.0%	65.7%	65.5%	65.9%	70.2%	67.2%	65.7%
Total final output	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Transport Equipment

Share of regional value added embodied in final manufacturing output

Region	Maquiladora									Manufactura Global				
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
USA and Canada	71.7%	68.8%	66.5%	65.4%	64.0%	61.6%	56.4%	52.2%	49.6%	35.4%	31.6%	31.6%	29.5%	31.3%
East Asia	3.5%	4.6%	4.4%	3.6%	3.9%	4.8%	7.7%	9.7%	10.1%	7.4%	7.6%	6.7%	7.8%	8.6%
Europe	3.2%	3.3%	3.6%	3.6%	3.8%	4.3%	5.6%	5.7%	6.1%	7.6%	9.3%	9.5%	6.0%	6.1%
ROW	2.1%	2.7%	3.2%	2.8%	2.8%	2.9%	4.0%	5.2%	5.9%	4.5%	5.0%	3.9%	3.4%	3.9%
MEX (DOM)	6.5%	6.7%	6.7%	7.1%	7.6%	9.2%	9.6%	10.1%	11.4%	22.8%	23.7%	25.2%	31.6%	28.1%
MEX (MAQ/ Manuf Global)	13.0%	13.9%	15.6%	17.4%	17.8%	17.2%	16.6%	17.2%	17.0%	22.2%	22.8%	23.2%	21.7%	22.1%
Total final output	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Manufacturing, Nec; Recycling

Share of regional value added embodied in final manufacturing output

Region	Domestic Economy of Mexico													
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
USA and Canada	21.7%	17.9%	21.7%	19.3%	16.8%	21.3%	23.5%	20.3%	20.0%	19.6%	18.8%	19.9%	20.0%	21.2%
East Asia	1.5%	6.1%	1.6%	1.6%	1.7%	1.8%	1.8%	2.3%	2.6%	2.7%	2.9%	2.8%	3.2%	3.2%
Europe	2.9%	2.4%	2.3%	3.0%	2.7%	2.6%	3.0%	4.1%	4.1%	3.5%	3.3%	2.7%	2.9%	2.8%
ROW	1.8%	1.8%	2.2%	2.2%	5.7%	2.4%	2.6%	3.3%	3.3%	3.5%	3.7%	3.1%	3.7%	3.8%
MEX (DOM)	72.2%	71.7%	72.1%	73.9%	73.1%	71.9%	69.0%	70.0%	70.0%	70.8%	71.3%	71.5%	70.2%	69.1%
Total final output	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Manufacturing, Nec; Recycling

Share of regional value added embodied in final manufacturing output

Region	Maquiladora									Manufactura Global				
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
USA and Canada	67.0%	60.0%	63.4%	44.0%	32.9%	41.6%	33.4%	26.2%	23.5%	13.8%	15.7%	20.0%	22.8%	23.1%
East Asia	6.1%	7.5%	5.0%	20.8%	31.4%	18.6%	20.8%	24.6%	20.1%	34.1%	29.6%	28.7%	27.2%	27.3%
Europe	3.1%	3.3%	3.0%	3.1%	3.8%	5.5%	8.8%	9.1%	9.8%	10.1%	11.7%	10.7%	12.0%	12.3%
ROW	2.5%	7.2%	3.9%	4.9%	6.0%	7.5%	12.2%	14.9%	19.9%	12.7%	13.3%	12.7%	14.8%	14.6%
MEX (DOM)	7.3%	7.1%	8.1%	9.0%	8.1%	8.5%	7.7%	7.7%	7.9%	10.2%	9.5%	9.0%	7.1%	7.0%
MEX (MAQ/ Manuf Global)	14.0%	15.0%	16.7%	18.3%	17.8%	18.3%	17.1%	17.5%	18.7%	19.1%	20.1%	18.8%	16.0%	15.8%
Total final output	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chapter 6

The Micro-foundations of Productivity and of Productivity Growth in Mexico's Exporting sector: 1990-2014**

Abstract

This chapter studies labor productivity (and labor productivity growth) in Mexico's export promoting programs, both at the aggregate level and the firm level. To this end, we rely on official firm-level information for the Maquiladora industry (1990-2006) and on data for Mexico's new exporting program known as IMMEX (2007-2014). At the aggregate level, our findings indicate that the exporting sector does not contribute much to increases in aggregate labor productivity. Changes in labor productivity in domestic manufacturing drive productivity trends in total Mexican manufacturing. Upgrading (increases in value added output ratios) by exporting firms appears to have no role in productivity growth, and we even find that there is a negative but small contribution to productivity from changes in the value added to output ratio. At the micro-level, we find that the firms in the maquiladora dataset (up to 2007) are rather different from firms in the IMMEX dataset (from 2007). We identify GVC-intensive and non-GVC intensive firms in the IMMEX dataset, and find differences between them, and relative to the maquiladora firms, in terms of the microeconomic determinants of labour productivity.

JEL Codes: F14, L6.
Keywords: Firm-level, Maquiladora, IMMEX, Global Value Chains, Mexico.

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6.1 Introduction.

This chapter studies labor productivity (and labor productivity growth) in Mexico's exporting sector, both at the aggregate and the firm level. At the aggregate level, we seek to explain how Mexico's exporting sector contributes to changes in the aggregate labor productivity levels of Mexican manufacturing. At the micro-level, our objective is to understand variations in labor productivity in exporting firms, and to identify the factors that determine variations in productivity levels and productivity growth.

It is often the Maquiladora firms that attract attention as the exporting sector of Mexican manufacturing. However, there are also Mexican exporting manufacturing firms that do not work according the maquiladora model. Maquiladora firms are the assembly firms that export their entire output to the US. Firms belonging to the maquiladora program enjoy tariff exemptions for imported inputs and capital goods, provided by the Mexican government, and trade incentives within the NAFTA framework. In general, those firms mostly or even exclusively rely on imported intermediate inputs with a very limited use of domestic inputs.

Our analysis will attempt to shed some light on the role of the exporting sector in the development of labor productivity, relative to the domestic sector, and in terms of the distinction between maquiladora firms and other exporting firms. Following the available data, during the period up to 2006, we define the exporting sector exclusively as firms in the so-called Maquiladora export promoting program. Since 2007, we not only include Maquiladora firms in the export sector, but also a broader set of export-oriented firms that produce both for the domestic market and for export markets and meet certain minimum export criteria to qualify for the so-called IMMEX program. The manufacturing firms that do not belong to the Maquiladora program (before 2006) or to the IMMEX program (after 2007) are considered as the domestic manufacturing sector of Mexico. These firms produce both for the domestic and the foreign market.

Previous studies of labor productivity for Mexican manufacturing have only considered the evidence from the exporting sector and from domestic manufacturing separately, and they have also focused exclusively on the maquiladora firms in analyzing the exporting sector. Little is known about the micro foundations of productivity performance and the ways in which they affect the comparative contributions of the domestic and export sectors to total productivity. Our research aims to cope with these limitations. We will first study how Maquiladora and IMMEX firms contribute to aggregate changes in the labor productivity trends of Mexican manufacturing. We will compare maquiladora and IMMEX firms to the domestic part of Mexican manufacturing, and also implement a comparison of the maquiladora and IMMEX definitions of the exporting sector. The latter comparison is difficult because the time periods for which both datasets (or definitions) are available do not overlap. However, we will still be able to present some indirect evidence on the role of maquiladora firms versus other exporting firms.

Subsequently, we will study the firm-level variation of labor productivity in the maquiladora and IMMEX datasets. We are unable to directly observe maquiladora firms in the IMMEX dataset, but will attempt to identify them based on the fraction of exports to total production, and import of intermediates to total intermediate use. In this way, we will be able to compare maquiladora firms and other exporting firms for the IMMEX period. Although our macro-analysis also includes the aggregate labor productivity performance of domestic manufacturing and its role in explaining changes in aggregate labor productivity levels and trends in Mexican manufacturing, there are no micro data for domestic manufacturing. Therefore, our research cannot empirically extend the analysis to the micro foundations of firms in the domestic manufacturing sector.

Our general research question is the following: which variables within the exporting sector can explain the trends in labor productivity in Mexican manufacturing, and the differences between firms in terms of labor productivity? We propose several sub-questions that further elaborate these issues both at the aggregate and the micro level. At the aggregate level, the main question concerns the contribution of the exporting sector and of domestic manufacturing to changes in aggregate labor productivity of Mexican manufacturing.

At the micro level, we seek to explain how and why firms differ with regard to the key factors that induced changes in labor productivity performance at the aggregate level. Which are the firm-level sources of variation in levels and growth rates for those elements within the exporting sector? In this part of the analysis, we will not only explain how different firm-level variables affect variations in plant-level productivity in the export sector, but also, and more importantly, we will also explain how those firm-level variables can trigger changes in aggregate labor productivity levels in the export sector and changes in the aggregate productivity levels of Mexican manufacturing.

This research has several novel elements. Not only do we propose a framework to understand the micro and macro foundations for the contribution of firms engaged in Global Value Chains (GVCs) to changes in the total manufacturing productivity of a given country, our research will also provide a temporal perspective. This is because we will utilize two official firm-level datasets that permit the analysis of firms in global value chains (GVCs): the Maquiladora firm-level dataset (1990-2006), and its latest update, the IMMEX firm-level dataset (2007-2014). This will provide insights into the role of maquiladora firms compared to other exporting firms.

Our main findings are the following. At the aggregate level, we observe that the export sector in Mexico plays a limited role in labor productivity growth in total Mexican manufacturing. Domestic manufacturing is the sector driving most of the changes. Similarly, upgrading (defined as increases in the value added to output ratio) in exporting firms is also found to be relatively unimportant for aggregate changes in labor productivity[37].

At the micro-level, capital per worker, gross output, the ratio of highly skilled workers to low skilled workers, as well as changes in the composition of labor are positively

[37] These ideas further confirm that the export sector is more attuned to Mexican factor proportions with abundant cheap labor. Along the same lines, the higher productivity of the domestic sector is probably the result of a misallocation of resources and a capital bias.

associated with higher plant-level labor productivity at exporting firms. Conversely, a higher consumption of imported intermediate inputs is found to have a negative impact on firm-level productivity. An error correction model specification indicates convergence to the long-run equilibrium in labor productivity levels for maquiladora and GVC-intensive firms.

This chapter is structured as follows. Section (6.2) reviews the literature. Here, we discuss previous studies that deal with the evolution of productivity in Mexican manufacturing. Section (6.3) presents our aggregate information and introduces a technique to decompose changes in labor productivity. This section also presents labor productivity decomposition results at the sectoral level and for different time periods. Section (6.4) indicates our firm-level evidence for maquila and IMMEX firms. Here, we also identify sub-groups of firms within the IMMEX dataset (GVC intensive and non-GVC intensive). Section (6.5) presents our econometric specification (the Error Correction Model) and explains the selection of independent variables for the micro-economic analysis. In this same section, we present our econometric results for maquiladora and for the sub-groups of firms within IMMEX. Conclusions and points for further discussion are provided in section (6.6).

6.2 Literature Review: The Evolution of Productivity in Mexican Manufacturing.

The main objective of this literature review is to understand the evolution of productivity of Mexican manufacturing firms since the mid 1980s, when the country decided to open its economy to foreign markets. To this end, we will rely on the information provided in table 6.1, which summarizes the main findings from different scholars that analyzed productivity in Mexican manufacturing, considering different time periods, different measures (total factor productivity or labor productivity), as well as different datasets. The use of different datasets (the last column of table 6.1) was our main criteria to determine which component of Mexican manufacturing was being analyzed. Studies relying on information from the National Accounting System were regarded as studies for the productivity of the total manufacturing sector in Mexico. Those relying on the *Encuesta Industrial Anual* were considered to refer to the domestic manufacturing sector and those using the EMIME dataset were regarded as part of Maquiladora[38] (exporting sector). In the forthcoming paragraphs, we will indicate that the productivity growth for domestic manufacturing has been generally larger than for Maquiladora and/or the total economy of Mexico considering different methodologies and different periods of time.

6.2.1 Productivity within Total Manufacturing.

The first panel of table 6.1 indicates results for the average productivity growth in the total economy of Mexico. By observing the results for total factor productivity (TFP), we can see that the average growth of productivity in Mexican manufacturing seems to be positive and more stable in the decades prior to the opening up of the country (1950-1974 and 1960-1980) than in the first years of trade liberalization (1983-1989).

[38] Prior to the present study, there are no studies that analyze the labor productivity of IMMEX firms.

According to Mollick and Cabral (2009), TFP appears to be negative in the NAFTA period (1994-2000). Those negative TFP results seem to be confirmed by Loayza et al. (2004). As for the calculations of labor productivity, we see that its average growth rate falls in the years that followed the liberalization of economy (1983-1989 and 1980-1993), compared to the earlier decades. In the NAFTA period, labor productivity only shows small positive average growth. Given the negative TFP growth during the same period, the latter would suggest that capital intensity increased.

6.2.2 Productivity within Domestic Manufacturing.

Results for the productivity of firms belonging to the domestic manufacturing sector of Mexico are presented in the second panel of table 6.1. Firms in the domestic manufacturing of Mexico have been analyzed by relying on the information contained in the *Encuesta Industrial Annual* (EIA). This is an official firm-level data-set collected and compiled by Mexico's statistical office (INEGI). The data-set provides plant-level information on the number of employees, hours worked, wages, value of production and sales, exports, value of intermediate inputs, inventories, investment, etc. (De Hoyos and Iacovone, 2013). It is important to note that EIA explicitly excludes the informal sector (i.e. unregistered firms) and maquiladora firms (Montes-Rojas and Santamarina, 2007). The reason for the exclusion of maquiladora firms from EIA is the fact that there is a separate industrial survey for exporting firms (EMIME and, since 2007, the IMMEX program). Various authors have studied the productivity of domestic manufacturing relying on different updates and data from the EIA.

Table (6. 1): Summary of Estimates of TFP and of Labor Productivity Annual Average Growth. Mexican Manufacturing.

Total Economy of Mexico

Author	Period	Total Factor Productivity (%)	Labor Productivity (%)	Data source
Chenery (1986)*	1950-1974	2	3	National Accounts
Hernández Laos and Velasco (1990)*	1960-1980	1.1	3.4	
Hernández Laos (1991)*	1983-1989	5.3	2.1	
Loayza, Fajnzylber & Calderon (2004)**,[a]	1981-1990	6.9		
Loayza et al. (2004)**,[a]	1991-2000	-19.2		
Mollick and Cabral (2009)***	1980-1993	-3.37	2.4	Data from Nicita and Olarreaga (2006).
	1994-2000	-1.26	1.31	

Domestic Economy of Mexico

Author	Period	Total Factor Productivity (%)	Labor Productivity (%)	Source
Samaniego (1984)*	1963-1981	3.6	6	Encuesta Industrial Anual
Fragoso (2002)***	1970-1979	0.3	1.8	
	1980-1989	1.9	2.7	
	1980-1983	-3.5	-0.9	
	1984-1989	4.1	3.1	
Brown and Dominguez (1999)*	1984-1990	4.8	3.3	
Fragoso (2002)***	1990-1998	2.9	4.2	
	1990-1994	5	6.7	
	1995-1998	0.8	1.7	
Montes-Rojas & Santamaria (2007)**	1994-2002	-0.6	3.24	
	1995-2002	0.31	4.27	

Maquiladora

Author	Period	Total Factor Productivity (%)	Labor Productivity (%)	Source
González-Arechiga & Ramirez (1989)***	1980-1986		-4.26	EMIME
Cortez (1999)***	1990-1996		1	
Mendoza (2004)***,[a]	1990-1999		-0.36	
Díaz González (2006)***,[a]	1991-2004	– 0.7		
Utar & Ruiz (2013)***	1999-2006	0.078		
Castillo & De Vries (2018)***,[a]	1981-2006		-0.8	

Source: * Brown and Dominguez (1999), ** Montes-Rojas & Santamaria (2007) and, *** this research.
[a] Growth rates were here calculated with the information provided by the respective authors.

Fragoso (2002) analyzed the evolution of TFP in domestic manufacturing from the 1970s to the end of the 1990s. The author relied on three versions of EIA that differ in terms of the period covered (1970-1983, 1984-1994, and 1994-1998). According to Fragoso (2002), the largest increase of TFP took place between 1990 and 1994 (an average TFP growth rate of 5% during those years). In addition, the results from Fragoso (2002) also indicate that the average growth rate of labor productivity seems to have declined by the end of the 1990s (1995-1998).

Montes-Rojas and Santamaria (2007) relied on the information contained in EIA to analyze the evolution of labor productivity and TFP from 1994 to 2002. According to those authors, labor productivity increased significantly during this period (an average annual growth rate of 3% for 1994-2002 and, 4% for 1995-2002). In their calculations, the crisis of 1994-1995 initially resulted in a decline of labor productivity of 7%. But there was a rapid recovery in productivity in the subsequent years. Montes-Rojas and Santamaria (2007) also indicate that their findings for TFP are very different from those for labor productivity. Their estimates yield negative or small increments in TFP with a maximum decline of 5% and a minimum decline of 0.6%. In their view, the observed stagnation or decline in TFP can be explained by the important increase in investment, which was not mirrored by a similar increase in output. Therefore, the differences between labor productivity and TFP can be attributed to the acquisition of capital goods, which significantly increased output per worker although it did not increase output enough to increase total factor productivity. Finally, their findings also indicate that productivity growth was higher in sectors with medium-size firms and relatively abundant low-skilled labor. This result is in line with the idea that NAFTA favored sectors relatively abundant in non-skilled labor.

De Hoyos and Iacovone (2013) studied the impact of NAFTA on firm-level productivity. They also relied on the EIA data-set from 1993 to 2002. Their findings indicate that NAFTA stimulated the productivity of Mexican plants via an increase in import competition and easier access to imported intermediate inputs. Nevertheless, they also argue that the impact of trade reforms was not identical for all firms, because only fully integrated firms (firms simultaneously exporting and importing) could benefit more from the incentives provided by NAFTA and achieve higher levels of productivity than the rest of firms within Mexican domestic manufacturing.

6.2.3 Productivity within the Maquiladora Industry.

Studies dealing with the evolution of productivity in maquiladora industry are presented in the last panel of table 6.1. These studies can be divided into those that have relied on the official maquiladora firm-level and aggregate data-sets, and those that have collected their own non-official plant-level information. The official source of information for the maquiladora program is contained in the *Encuesta Mensual de la Industrial Maquiladora de Exportación* (EMIME). Both at the aggregate level and firm-level, EMIME offers information similar to that contained in EIA in terms of gross output, value added, imported and domestic intermediate good, labor qualification, and so forth (for specific details about the EMIME dataset, please refer to section 6.4). The aggregate maquiladora information is available from 1980 to 2006, while the firm-level data-set can be obtained from 1990 to 2006.[39]The studies based on non-official plant level data on maquiladora firms have focused on the dynamics of major industrial centers (such as the Mexican municipalities of Tijuana, Reynosa, Monterrey, etc.), considering key manufacturing sectors (mostly electronic and textiles) for a limited number of years.

González-Arechiga and Ramírez (1989) performed one of the first studies to analyze the evolution of productivity in maquiladora firms, by combining both aggregate and non-official plant level information. According to their findings, during the period from 1980 to 1986, gross output per worker in the maquiladora industry grew considerably (an average growth rate of 12%). Nevertheless, labour productivity levels in maquiladora

[39] 2006 is the last year of observation for those two aggregate and micro data-sets due to the fact as of 2007 maquiladora data is now reported within the framework of the IMMEX program.

declined when productivity was measured as value added per worker (an average growth rate of -4% during 1980-1986). Cortez (1999) indicates low labor productivity growth from 1990 to 1996 in major Maquiladora northern states (Sonora and Baja California). In his view, the reasons for low labor productivity growth are the lack of technological learning due to continuous rotation of low-skilled labor in maquiladora firms and, the lack of a linkage between higher investment rates and higher labor productivity growth rates. At the sectoral level, Cortez (1999) indicates that the increasing use of better technologies during those years in major sectors such as machinery and equipment did not necessarily imply higher labor productivity growth for maquila firms, because the the new technologies (embodied in machinery) needed considerable amounts of low qualified workers to operate it (Carrillo and Hualde, 1997).

Likewise, Mendoza (2004) studies the labor productivity performance in maquiladora industry at the aggregate level by considering different manufacturing sectors and regions in Mexico from 1990 to 1999. In this case, it is argued that different maquiladora sectors show different levels of sectoral productivity due to the existence of different levels of technology across sectors, differences in firm size, different labor qualification and different capital endowments. The author's calculations for labor productivity show no drastic changes when comparing the levels in 1990 (21.9) and the ones for 1999 (21.2), i.e., an average negative productivity growth of -0.36% (presented in table 6.1). Mendoza (2004) also indicates that machinery and equipment and chemical products were the sectors with the highest labor productivity levels during those years.

As for the case of electronic production (another key maquiladora sector), the TFP calculations of Díaz González (2006) indicate that the TFP growth of those firms (and that of the maquila industry as a whole) remained low from 1991 to 2004, with some signs of recovery by 2001. According to this author, the recovery in TFP can be explained by the exit of the least productive firms after 2000 (although the author is unable to provide empirical evidence for this specific issue). In our calculations of productivity growth, using TFP data from Díaz González (2006) for the first and final year of observation, average productivity growth is -0.7%.

An increase in maquiladora TFP growth levels after 2000 is confirmed at the firm-level by Utar and Torres-Ruiz (2013). Relying on the official EMIME micro dataset, those authors analyze impacts of the industrial emergence of China on maquiladora producers at firm level. Their findings indicate that increasing competition induced maquiladora firms to achieve higher productivity levels. However, their calculations for the average growth rate of TFP are very small (0.078% for 1999-2006). Following the same micro approach, Sargent and Mathews (2008) collect non-official plant-level information to determine which type of maquiladora firms were more likely to survive competition from Chinese producers. During the 1990s and early 2000s, they observe that the firms that survived were large (as measured by the number of employees). Furthermore, auto parts producers were much more likely to survive than maquiladoras in the electronic/electrical sector. Finally, Castillo & De Vries (2018) consider a long time span of 25 years. They divided real value added by hours worked, and constructed an index that equals 1 in 1981, finding that Maquiladora labor productivity had declined to 0.82 by 2006. Thus, Considering the whole period, an average annual negative productivity growth of -0.8% is observed[40] (table 6.1). Modest changes in labor productivity are also observed by those authors in key maquiladora sectors such as Textiles, Electronics and Transport equipment for the same period.

Concluding, we observe that maquiladora and domestic firms (and thus, total manufacturing in Mexico) have mostly followed a similar productivity trend over time. For instance, according to the TFP and labor productivity results described in table 6.1, productivity growth for total manufacturing and for domestic manufacturing was found to be low by the late 1980s, early 1990s and by the end of 1990s. After that decline, firms in domestic manufacturing once again show positive but limited productivity growth (in the early 2000s). Likewise, firms in maquiladora production had negative labour productivity rates during most of the 1990s and positive (but limited) growth in the early and mid-2000s. Even though we see a common pattern for all Mexican manufacturing firms, it is also worth observing that the productivity growth of domestic manufacturing firms seems to be higher most of the time than that of maquiladora and total manufacturing. The relative importance of domestic manufacturing is especially observed in the column for the results of labor productivity in table 6.1 and seems to become deeper as of the late 1980s. This indicates that, at least at the aggregate level, domestic manufacturing plays a more important role than maquiladora in determining productivity levels for Mexican manufacturing.

Despite the existence of all this useful information about the evolution of productivity in Mexican manufacturing, some other important conclusions are in order. One important issue is the lack of studies that deal with the evolution of Mexican manufacturing since the end of the 2000s. Those are necessary to understand the impact of events such as the 2008 crisis in maquiladora and domestic manufacturing firms. Similarly, there are no studies that take into consideration the evolution of productivity of firms in the IMMEX program from 2007 onwards. Analyzing the IMMEX program is very important given that it constitutes the only up-to-date source of information to analyze the current evolution of exporting firms in Mexico (Maquiladora firms and firms belonging to the PITEX program). More importantly, one key issue in the study of the evolution of productivity levels in Mexican manufacturing is that exporting and domestic manufacturing firms have only been analyzed separately. Little is known as to how each component contributes to aggregate productivity levels in total Mexican manufacturing. The next sections of this chapter will try to cope with all these limitations.

6.3 The Productivity Contribution of the Exporting Sector: an Aggregate Perspective.

The main objective of this section is to assess the contribution of the exporting sector to aggregate manufacturing labor productivity in Mexico. We will provide descriptive evidence in terms of the construction of time series for labor productivity and underlying variables, and also decompose changes in aggregate labor productivity in

[40] According to our calculations in section 6.3.2, annual labor productivity growth for Maquiladora firms is of 1.1% between 1990-2006. By comparing these results to the estimates fron Castillo & De Vries (2018) for 1980-2006 (-0.8%), we can infer that Maquiladora firms experienced rather negative growth during the years between 1980 and 1990.

Mexican manufacturing over time. Our level of analysis will either be total manufacturing, or a subsector of manufacturing, but never the individual firm. The analysis of firm level micro data is left for the next section.

We use three sources of aggregate data (all available at www.inegi.gob.mx). The first source of information is data from Mexico's National Accounting System (NAS). These data refer to Mexico's total manufacturing (1990-2014). The second source is data for Maquiladora retrieved from EMIME (1990-2006) and, the third one is information for the IMMEX program (available from July 2007 to 2014). Our estimates for domestic manufacturing were always obtained as the difference between the data for total manufacturing and the data for exporting firms (either Maquiladora or IMMEX program).[41]

The Maquiladora (EMIME) and IMMEX datasets not only cover different time periods, they also cover different types of firms. Firms in the maquiladora dataset are all participants in international value chains, more specifically they are assembly firms which import intermediate goods from the US and export their total final output to the US. The IMMEX dataset not only includes these Maquiladora firms, but also a broader set of export-oriented firms that produce both for the domestic market and for export markets and meet certain minimum export criteria to qualify for the so-called IMMEX program.[42] Thus, using IMMEX, we apply a broader definition of the exporting sector than just the maquiladora.On the one hand, the discontinuity between the maquiladora and IMMEX datasets provides a problem for assessing the contribution of the exporting sector to the development of labour productivity, because the definition of the exporting sector changes over time. On the other hand, this provides an opportunity to compare the impact of the pure maquiladora firms to the other exporting firms in Mexican manufacturing. In this section, we will implement this comparison by comparing the time periods covered by our two datasets, maquiladora and IMMEX. In the next section, we will provide a sharper analysis by trying to identify the maquiladora firms in the micro-level IMMEX dataset.

Let us explain in detail the data and variables related to total manufacturing, Maquiladora and IMMEX program. Information on gross output and value added was directly available for total manufacturing. However, in the case of Maquiladora and IMMEX additional calculations had to be made. For maquiladora firms, gross value added was computed as the sum of labor remuneration, utilities and the rental cost of machinery and equipment. For the same set of firms, intermediate consumption was

[41] Data for the Domestic Manufacturing of Mexico is the same as has been already been used in Chapter 5 of this dissertation (*Mexican Manufacturing and its integration into Global Value Chains)*. Differences in the period being analyzed in Chapter 5 and in this one, as well as the compatibility of information are the main reason for us not to rely here in Chapter 6 on the direct information for domestic manufacturing. Our research could access aggregate and micro information for EMIME and IMMEX from 1990 to 2014. Aggregate information for domestic manufacturing (as presented in EIA) was only available from 1994 onwards. Thus, since our research wanted to analyze the pre-NAFTA period for maquiladora, we decided to rely on the complete time-series information offered by the NAS and compute domestic manufacturing as a residual.

[42] Prior to 2007, there was also an export programme called PITEX which supported firms that exported at least 10 percent of their output. In our analysis however, these non-Maquila firms were included in the domestic sector. After 2007, these PITEX firms would be included in the IMMEX category.

regarded as the sum of imported and domestic intermediate goods and total intermediate expenses. The sum of gross value added and of intermediate consumption provides our estimate of maquiladora gross output.

On the other hand, information for IMMEX was more difficult to compute. Unlike EMIME, IMMEX does not publish data entirely in line with the NAS. In this context, following the concepts from INEGI (2012) and the information provided in the official IMMEX industrial surveys, gross value added had to be computed as a residual. From the IMMEX variable named "*Ingresos por Maquila, Submaquila and Remanufactura*" (i.e., income obtained as a result of maquiladora-related operations) we subtract the value of domestic intermediate inputs.[43] The residual of this computation is our measure of gross value added for IMMEX firms. Gross output for IMMEX firms is regarded as the sum of the variable named "income obtained as a result of maquiladora related operations" and the variable accounting for imported intermediate consumption. Total intermediate consumption for IMMEX was computed following the same procedure as for maquiladora firms. Once we obtained all this information for total manufacturing, Maquiladora and IMMEX, value added and output deflators were utilized to convert the data to constant Mexican pesos of 2008. Finally, for the case of variables measuring employment, we faced no major difficulties since INEGI directly publishes such information for total manufacturing, Maquiladora firms and firms under the IMMEX program.

6.3.1 A Decomposition Method.

In this section, we discuss the methodology used to identify how exporting firms (Maquiladora and IMMEX firms) and domestic manufacturing firms contribute to changes in total manufacturing productivity. Before illustrating the mathematical steps we follow, some definitions are in order. We define manufacturing productivity as the ratio of gross value added to manufacturing employment. Gross value added is the sum of labor remuneration (which consists of wages but also of all other labor related expenditures), profits and the rental cost of capital. In the case of the total manufacturing sector, value added (Y) is the sum of the value added created by exporting firms (Y^M) and the that created by producers in the domestic economy of Mexico (Y^D). Also, total manufacturing employment (L) is the sum of workers employed in the exporting sector (L^M) and, those workers in domestic manufacturing (L^D). In this context, total manufacturing productivity in Mexico can be defined as follows:[44]

$$\frac{Y}{L} = \frac{Y^M + Y^D}{L^M + L^D} \qquad (6.1)$$

We can expand equation (6.1) to include the share of labor in the export sector (and of labor in domestic manufacturing) in total manufacturing labor in Mexico:

[43] In line with "*Cuestionario Mensual para Establecimientos Manufactureros-Programa IMMEX*", the variable named "*Ingresos por Maquila, Submaquila y Remanufactura*" is computed considering the sum of production costs (labor, depreciation of capital, domestic inputs, etc.) plus total expenses and utility.

[44] From 2007 onwards, the superscript M in our equations (and in our calculations) no longer refers to Maquiladora but to the IMMEX sector (Maquiladora, PITEX plus new type of IMMEX firms).

$$\frac{Y}{L} = \frac{Y^M + Y^D}{L^M + L^D} = \frac{Y^M}{L^M}\frac{L^M}{L^M + L^D} + \frac{Y^D}{L^D}\frac{L^D}{L^M + L^D} = \frac{Y^M}{L^M}\sigma^M + \frac{Y^D}{L^D}(1 - \sigma^M) \qquad (6.2)$$

In this case $\sigma^M = \frac{L^M}{L^M + L^D}$ refers to the share of labor employed in the export sector in total manufacturing employment, while $(1 - \sigma^M)$ refers to the share of domestic manufacturing employment in total manufacturing employment. Now, given that our objective is to study changes in manufacturing labour productivity over time, we write equation (6.2) as a change in the level of productivity (with subscript 0 referring to the begin of a period and 1 to the end, and the delta indicates a change between periods 0 and 1):

$$\Delta\frac{Y}{L} \equiv \frac{Y_1}{L_1} - \frac{Y_0}{L_0} = \Delta\left(\frac{Y^M}{L^M}\sigma^M\right) + \Delta\left[\frac{Y^D}{L^D}(1 - \sigma^M)\right] =$$

$$\left(\frac{v_1 X_1^M}{L_1^M}\sigma_1^M - \frac{v_0 X_0^M}{L_0^M}\sigma_0^M\right) + \left[\frac{Y_1^D}{L_1^D}(1 - \sigma_1^M) - \frac{Y_0^D}{L_0^D}(1 - \sigma_0^M)\right] \qquad (6.3)$$

Note that in this equation we also made the substitution $Y^M = vX^M$, where X^M refers to gross output produced by the exporting firms, and v is the value added-to-gross-output ratio (which is also the upgrading variables). For Maquiladora firms, by definition, gross output equals gross exports, which is why in this case we use the symbol X for gross output. This is because, as mentioned in previous chapters, firms within Maquiladora receive tariff exemptions provided that all their gross output is exported. However, the IMMEX program includes both Maquiladora and PITEX firms, and firms in the unified framework of IMMEX (either Maquiladora or PITEX firms) receive tariff exemptions provided that at least 10% of their gross output is exported. Hence, for the case of IMMEX, gross output is no longer equal to gross exports. We nevertheless use the symbol X for gross output of firms in the exporting sector. Through a series of intermediate steps, equation (6.3) can be re-written to obtain a decomposition of the change of aggregate labor productivity into four terms, each of which includes a weighted change (delta term) of one of the main variables in the analysis. However, the weights in this procedure are not unique, there various possible weighting schemes in terms of whether values from either the 0 or 1 period are used. As is common in the literature (Dietzenbacher et al., 2000), we use two of these possible decompositions, as follows:

$$\Delta\frac{Y}{L} = v_0\sigma_0^M\Delta\frac{X^M}{L^M} + \frac{X_1^M}{L_1^M}\sigma_0^M\Delta v + \left(v_1\frac{X_1^M}{L_1^M} - \frac{Y_1^D}{L_1^D}\right)\Delta\sigma^M + (1 - \sigma_0^M)\Delta\frac{Y^D}{L^D} \qquad (6.4)$$

$$\Delta\frac{Y}{L} = v_1\sigma_1^M\Delta\frac{X^M}{L^M} + \frac{X_0^M}{L_0^M}\sigma_1^M\Delta v + \left(v_0\frac{X_0^M}{L_0^M} - \frac{Y_0^D}{L_0^D}\right)\Delta\sigma^M + (1 - \sigma_1^M)\Delta\frac{Y^D}{L^D} \qquad (6.5)$$

As can be noted, the timing of the weights in equations (6.4) and (6.5) is exactly 'polar' to each other, i.e., where a value from period 0 appears in one equation, a period 1 value appears in the other equation, and vice versa. We then define a decomposition with 'average polar' weights as:

$$\Delta\frac{Y}{L} = \frac{1}{2}[v_0\sigma_0^M + v_1\sigma_1^M]\Delta\frac{X^M}{L^M} + \frac{1}{2}\left[\frac{X_1^M}{L_1^M}\sigma_0^M + \frac{X_0^M}{L_0^M}\sigma_1^M\right]\Delta v + \frac{1}{2}\left[\left(v_1\frac{X_1^M}{L_1^M} - \frac{Y_1^D}{L_1^D}\right) + \left(v_0\frac{X_0^M}{L_0^M} - \frac{Y_0^D}{L_0^D}\right)\right]\Delta\sigma^M + \frac{1}{2}[(1 - \sigma_0^M) + (1 - \sigma_1^M)]\Delta\frac{Y^D}{L^D} \qquad (6.6)$$

This is the formula that we will use for the decomposition of aggregate Mexican manufacturing labor productivity. It indicates that labor productivity in Mexican manufacturing can change a result of the following factors: (1) a change of gross exports per worker in the export sector, $\Delta \frac{X^M}{X^L}$, (2) a change of the value added to output ratio in the export sector (or upgrading), Δv, (3) a change of the share of manufacturing employment in the export sector, $\Delta \sigma_M$, and, (4) a change of labor productivity in domestic manufacturing firms $\Delta \frac{Y^D}{L^D}$. We will apply this decomposition to the period from 1990 to 2014 in the next section.

6.3.2 Decomposition of Aggregate Manufacturing Labour Productivity

Table 6.2 presents our estimates for aggregate labor productivity in Mexican manufacturing from 1990 to 2014. Here, we observe labor productivity levels (thousands of constant Mexican pesos of 2008) for the export sector, domestic manufacturing and total manufacturing, considering all manufacturing sectors [45].

In order to better understand the information contained in table 6.2, we refer to figure (6.1). Such figure is divided into two panels. The first panel (figure 6.1.1) indicates labor productivity levels (the same as in table 6.1), while the second panel (figure 6.1.2) studies labor productivity growth rates. In each of those two panels, we observe the evolution of labor productivity (in terms levels or in terms growth, respectively) for the export sector, domestic manufacturing and total manufacturing. Let us now describe the tendency observed in each panel. The most striking element in the top panel of the figure is the watershed difference between the two definitions of the exporting sector. Up to 2006, the maquiladora sector shows a much lower level of labour productivity than the domestic sector, resulting in labor productivity levels for the exporting sector being very much lower than the aggregate. From 2008 onwards, however, with the new (IMMEX) definition of the exporting sector, the labour productivity level of exporting firms are above the domestic sector, and hence also above the average level in manufacturing. This clearly illustrates that we must look at the maquiladora and IMMEX definitions of the exporting sector as very much different from each other, and it points to the importance of comparing maquiladora and other exporting firms, something we will attempt to do below.

[45] Appendix A6.1 presents the raw data (total and per manufacturing sector) for gross value added and labor that were used in the calculation of labor productivity in table 6.1. Furthermore, it also presents calculations for labor productivity levels (total and per manufacturing) for the export sector, domestic manufacturing and total manufacturing.

Table (6. 2). Labor Productivity in Maquiladora, IMMEX, Domestic and Total Economy. All Manufacturing Sectors. Thousands of Mexican pesos (constant prices of 2008).

Year	Maquiladora	Domestic Manufacturing	Total Mexican Manufacturing
1990	154	564	519
1991	155	627	571
1992	147	596	541
1993	126	540	486
1994	126	555	495
1995	158	740	647
1996	187	858	744
1997	151	655	562
1998	149	597	512
1999	154	585	498
2000	152	543	462
2001	177	527	461
2002	163	540	464
2003	176	563	485
2004	167	583	492
2005	172	666	557
2006	182	726	606
Year	**IMMEX**	**Domestic Manufacturing**	**Total Mexican Manufacturing**
2008	896	478	624
2009	885	537	660
2010	865	488	625
2011	903	501	649
2012	856	495	630
2013	941	510	675
2014	860	471	621

Source: Source: Author’s calculation using data from INEGI’s National Accounting System (1990-2014), EMIME (1990-2006) and, IMMEX (2008-2014).

Apart from the differences in levels, figure (6.1) confirms the finding from our literature review that the export sector, domestic manufacturing and total manufacturing have followed (in general) the same tendency in labor productivity over time. Exporting firms, firms in domestic manufacturing and the total manufacturing of Mexico experienced an important increase in their labor productivity levels after 1994 and also faced a major decline in those levels by 1998. The signing of NAFTA and the currency crisis in Mexico (both taking place in 1994) implied higher productivity levels both for exporting and domestic firms. Booming labor productivity levels lasted for about three years (1994-1997). Once the initial effervescence from NAFTA finished and the Mexican economy reached some stability (after having faced a major currency crisis), a decline in labor productivity levels is observed (1998). For Maquiladora firms, this decline in labor productivity levels coincides with a new tax regulation imposed on the profits generated by these firms (see Chapter 2 for details). Finally, we also observe a steady increase in productivity levels after 2001 and up to 2006 (both for exporting and domestic firms, as well as for total manufacturing). But from 2008 onwards, which is the period of the new IMMEX dataset, labor productivity no longer grows.

On the other hand, the finding from our literature review that labor productivity growth in domestic manufacturing is higher than that of the export sector is only partially supported by figure (6.1.1). At least for some year intervals, annual labor productivity growth has been higher for the export sector than for domestic manufacturing. These year intervals are 1998-2003 for Maquiladora firms, and the years 2011 and 2013 for IMMEX. For Maquiladora, higher productivity levels from 1998-2003 are associated with the recuperation of the export promoting sector after drastic decreases in labor productivity. More importantly, such higher productivity for maquila firms is reflecting the competitive pressures that the export sector faced in light of the industrial emergence of China and its accession to the WTO (2001). For the case of IMMEX, higher labor productivity levels than domestic or total manufacturing can be also be explained by the recuperation of the export sectors after the 2008 financial crisis and, also, as result of the change in dataset. Finally, let us discuss the overall growth rates for the export and domestic sector during the two periods here considered (1990-2006 and, 2008-2014). As for the export sector, we observe that Maquiladora presents annual productivity growth of 1.1% between 1990 and 2006, while the one for the IMMEX program is of -0.7% between 2008 and 2014. Regarding the domestic sector, we observe annual productivity growth of 1.8% between 1990 and 2006 and of -0.3% between 2008 and 2014. In this context, we can infer that the annual productivity growth at the export sector is generally slower and less positive than that of the domestic sector when considering the years between 1990-2006 and 2008-2014.

Figure (6.1. 1): Aggregate Labor Productivity in Mexican Manufacturing: 1990-2014. All Sectors. Thousands of Mexican pesos (Constant Prices of 2008).

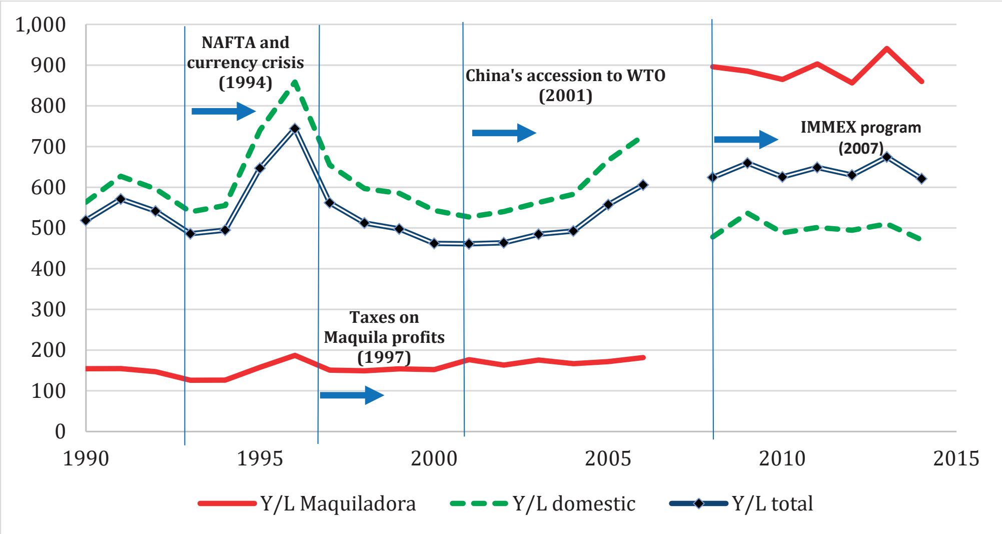
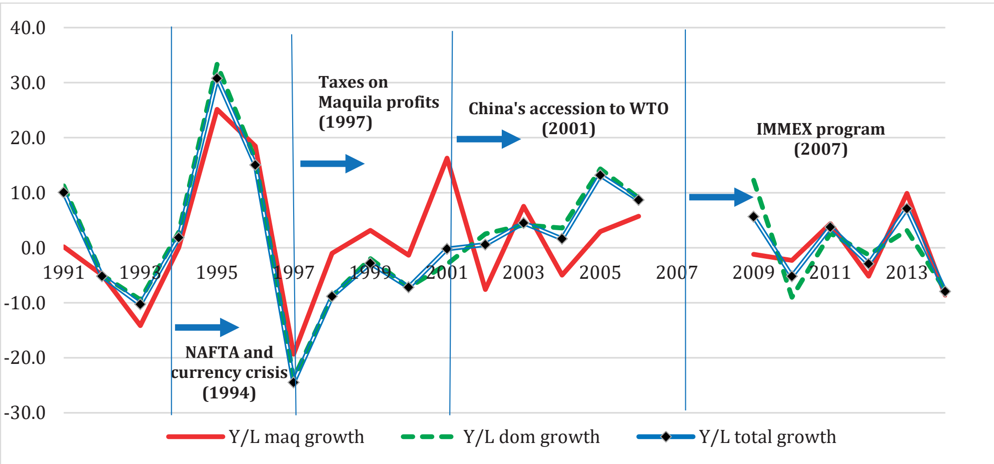


Figure (6.1. 2): Aggregate Labor Productivity Growth (%) in Mexican Manufacturing: All Sectors. Maquiladora (1990-2006) and IMMEX (2008-2014).



Notes: For IMMEX, the productivity growth rate in 2006-2007 is here excluded due to incompatibility of information between EMIME and IMMEX.
Source: Author's calculation using data from INEGI's National Accounting System (1990-2014), EMIME (1990-2006) and, IMMEX (July 2007-2014).

We now proceed to study the contributions to changes in the aggregate labor productivity levels of Mexican manufacturing, according to the four factors described in equation (6.6). We present decomposition results for different time periods that are relevant in the evolution of Maquiladora/IMMEX firms or the Mexican economy at large. For instance, we include the signing of NAFTA and the currency crisis (1994), the industrial emergence of China and the US crisis (2001), the positive expansion of Maquiladora after a major drop of productivity in 1997 (1998-2003 according to figure 6.1), the available years to study IMMEX firms (2008-2014) as well as the first and final years of observation in the Maquiladora. Table 6.3 presents the decomposition results, and is divided into four main panels that present our productivity decomposition results for the total manufacturing sector, and three key exporting sectors (Textiles, Transport equipment and Electrical equipment)[46].

If we focus on the entire period (1990 – 2006) for the maquiladora definition of the exporting sector, we see a negative contribution (sum of A – C) of the exporting sector to labor productivity growth in Mexican manufacturing. Labor productivity grows by almost 17% over this entire period, or which 26%-points (factor D) are attributed to the productivity growth bonus that the domestic sector enjoys over the exporting sector. Hence a –9%-points contribution is seen for the exporting sector. When we further divide this into the factors A – C, we see that it is mainly factor C that is responsible for this. Factor C represents the increase in employment share of the maquiladora sector, which has a negative effect on aggregate productivity because the sector's labor productivity level is below that of the domestic sector. In addition to this, the upgrading factor (B) also has a negative, but much smaller, impact, due to the fact that the value added to output ratio goes down in the maquiladora sector over this period. Gross output per worker increases somewhat, which has a (small) positive effect.

Interestingly, this aggregate picture can be much different at the sectoral level. In textiles, we observe modestly negative labor productivity growth over the entire period, but with all the signs of the effects A – C the same as in the aggregate manufacturing case. In Transport equipment, all effects have the same sign as in the aggregate manufacturing case, except for the upgrading factor B, which has a modestly positive effect. In Electrical equipment, the maquiladora sector has a positive overall effect on labor productivity growth (sum of A – C). Here, the only maquiladora factor with a negative sign is the upgrading factor B, which is very strongly negative at –37.5%, but this is "compensated" by a strong increase in gross output per worker (factor A).

The shorter time periods within the long 1990-2006 time stretch show fluctuating results, both at the level of aggregate manufacturing, and at the sectoral level. The 2001-2006 period appears as particular influential, representing the strong rise of China as an industrial power. During this period, the upgrading factor (B) is particularly strong and negative in all cases except transport equipment. Interestingly, the upgrading factor has a negative impact only in one other sub-period, i.e., 1990-1994.

[46] Appendix A6.2 presents similar decomposition results for the rest of manufacturing sectors not included in table 6.3.

Table (6. 3): Contribution to Changes in Aggregate Labor productivity (%)

Years	A (gross output / labor export sector)	B (upgrading export sector)	C (employment share export sector)	D (domestic sector)	%Δ(Y/L)=A+B+C+D
Total					
1990-1994	0.2	-0.9	-2.5	-1.4	-4.6
1994-1998	0.7	0.1	-4.3	7.0	3.6
1998-2001	0.8	0.2	0.1	-11.1	-10.0
2001-2006	2.1	-1.9	-3.3	34.4	31.4
1994-2001	1.5	0.2	-3.7	-4.8	-6.8
1990-2006	3.2	-2.3	-10.3	26.2	16.7
2008-2014	0.9	-3.0	2.4	-0.7	-0.5
Textiles					
Years	A (gross output / labor export sector)	B (upgrading export sector)	C (employment share export sector)	D (domestic sector)	%Δ(Y/L)=A+B+C+D
1990-1994	-0.1	-0.6	-3.3	-11.2	-15.2
1994-1998	2.9	1.1	-4.4	-3.9	-4.2
1998-2001	3.6	0.7	0.0	-26.1	-21.8
2001-2006	7.0	-4.4	0.0	49.9	52.5
1994-2001	5.6	1.7	-1.7	-30.7	-25.1
1990-2006	6.2	-1.1	-5.8	-2.5	-3.1
2008-2014	-1.4	0.5	1.1	20.5	20.8
Transport Equipment					
Years	A (gross output / labor export sector)	B (upgrading export sector)	C (employment share export sector)	D (domestic sector)	%Δ(Y/L)=A+B+C+D
1990-1994	0.2	-1.0	-2.5	9.4	6.1
1994-1998	-2.3	0.6	-2.5	13.3	9.0
1998-2001	2.9	-0.2	0.0	-11.0	-8.2
2001-2006	2.9	3.0	-4.1	43.3	45.2
1994-2001	0.7	0.4	-2.1	1.1	0.0
1990-2006	3.9	2.0	-10.2	58.4	54.1
2008-2014	0.3	-8.5	4.1	5.2	1.1
Electrical Equipment					
Years	A (gross output / labor export sector)	B (upgrading export sector)	C (employment share export sector)	D (domestic sector)	%Δ(Y/L)=A+B+C+D
1990-1994	6.3	-14.3	3.6	-5.3	-9.7
1994-1998	18.4	0.0	-2.9	10.0	25.6
1998-2001	12.9	-1.6	-4.3	-20.7	-13.7
2001-2006	-0.9	-19.4	17.0	77.5	74.2
1994-2001	34.2	-1.8	-8.4	-15.6	8.4
1990-2006	42.1	-37.5	9.3	56.7	70.6
2008-2014	-1.7	-4.1	-1.1	12.1	5.3

Notes: Δ indicates changes with respect to the previous year of observation.

Source: Author's calculation based on equation (6.6) using data from INEGI's National Accounting System (1990-2014), EMIME (1990-2006) and, IMMEX (2008-2014).

Focusing next on the IMMEX period, we see a different picture. For the case of all manufacturing sectors, the IMMEX years (2008-2014) show the an overall positive (but small) effect of the exporting sector, with factor C (increase of the share of the exporting sector) as the largest effect. This is now positive because the level of labor productivity in the exporting sector, in the IMMEX definition, is larger than that of the domestic sector. Upgrading (factor B) still has a negative, and comparatively strong impact.

Concluding, it makes a big difference whether we look at the Mexican exporting sector from the point of view of the maquiladora, or using the IMMEX dataset. The maquiladora dataset shows a sector that has comparatively low labor productivity, but grows rapidly, especially so in terms of employment. In roughly 25 years, Maquiladora increase from rather low shares in output to almost half of manufacturing production and half of manufacturing gross value added in Mexico, with an important and increasing share of total manufacturing employment. On the other hand, in the IMMEX dataset, the exporting sector appears as more productive than the domestic sector.

This suggests that the Mexican exporting manufacturing sector is in fact a heterogeneous sector. One part of it, the maquiladora, derives its dynamic impact on the Mexican economy by its ability to absorb large amounts of labor, while the other part also has a dynamic influence by higher productivity levels and growth rates. Thus, the impact of the maquiladoras in terms of raising living standards is mainly in terms of transferring labour from lower-productivity activities into manufacturing, and not so much in terms of upgrading labor productivity in manufacturing. Upgrading has never been strong in maquiladoras and this is a major brake on productivity growth. The sector has rapidly increased its contributions to output and employment, but could have made a much larger contribution to productivity if it had experienced more upgrading. The non-maquiladoras part of the Mexican economy (i.e. domestic manufacturing) is at an advantage in terms of labor productivity growth, but has not been able to absorb large amounts of workers.

6.4 Firm-Level Analysis

6.4.1. Data.

We now proceed to analyze the differences between the maquiladora and other part of the exporting sector at the microeconomic level. Our micro analysis will rely on two official unbalanced firm level panel data sets collected and compiled by INEGI; the first one is the EMIME (maquiladora) firm level dataset from 1990 to 2006 and, the second one is the IMMEX firm level dataset (July 2007-2014). These firm-level datasets were used as raw data by INEGI to construct aggregate information. Both EMIME and IMMEX report their own official variables at the aggregate and firm-level.

Let us first focus on the different information presented by the Maquiladora and the IMMEX datasets. As can be seen from appendix tables A6.1, when compared to Maquiladora, IMMEX has a higher share in total manufacturing for all relevant variables such as employment, gross output and value added. Focusing on the last year of observation for Maquiladora firms (2006) and, the first full year for IMMEX firms

(2008)[47], the difference is usually quite large. These differences are related to the number of firms included in the two datasets. According to INEGI (2011a), by December 2006, EMIME had collected information for 2,600 maquiladora firms while, by July 2011, the IMMEX dataset had collected data for 6,400 firms. Moreover, according to estimates provided by De La Cruz et al. (2001) from the total set of firms that were going to be considered part of the IMMEX program, by the end of 2006, 56% were PITEX firms and 44% Maquiladora firms. This would suggest that of the 6,400 IMMEX firms, about 2,800 could be considered maquiladora, which is slightly more than the 2,600 in the EMIME dataset. We will come back to these numbers when we present detailed information on the IMMEX dataset below.

The EMIME firm-level dataset consists of 34,728 plant-year observations (1990-2006). For each plant, there is information on hours worked, number of employees and wages all of them reported by gender and by job category (administrators, technicians and workers), as well as plant expenditures (energy consumption, telephone, services provided by third parties, custom procedures, freight, maintenance of buildings, fuels water consumption and other expenditures), domestic and imported intermediate consumption, value added and profits. The EMIME dataset also contains one variable related to capital expenditures named “expenditures on machinery and equipment”. According to Utar and Ruiz (2013), this variable refers to firm-level domestic expenditures on precision and resistance instruments, rotation bands, forklifts and, trucks with special containers (toxic waste). EMIME does not report plant-level expenditures on imported capital equipment.

The IMMEX dataset consists of 41,500 observations (July 2007 to December 2014). Plant level data for wages, number of employees, hours worked are also reported by job category. Nevertheless, unlike EMIME, IMMEX only reports data for two job categories, namely technicians and workers (lumped into a single category) and, administrative staff. In addition, IMMEX reports two different revenue categories that a firm might obtain from domestic or foreign market operations respectively. This refers to the categories of revenue obtained as a result of maquiladora related operations (*ingresos por maquila, submaquila y re-manufactura*) versus other revenues. IMMEX data for plant expenditures is less detailed than for EMIME. For instance, there is no IMMEX variable that directly quantifies firm-level expenditures on capital equipment. In this regard, the only available variable that approximates to capital equipment is “payments for the rent of movable assets”. IMMEX micro data for domestic and imported intermediates are reported in the same ways as for EMIME.

Table 6.4 presents basic firm-level statistics for four relevant Maquiladora and IMMEX variables included in equation (6.6). These are the value added to output ratio (v), the value added to employment ratio ($\frac{vX^M}{L^M}$), the output to employment ratio ($\frac{X^M}{L^M}$) and, the share of employment from the exporting sectors in total manufacturing employment in Mexico (σ^M). As mentioned in previous paragraphs, these firm-level variables were constructed following the same concepts and methodology as used at the aggregate level.

[47] For IMMEX firms, the information for 2007 only goes from July to December.

Table 6.4 confirms the mean higher value of productivity in IMMEX as compared to EMIME (maquiladora), both in terms of gross output per worker, and value added per worker. Also value added to gross output is higher (on the average) in IMMEX. We also note from table 6.4 that the degree of heterogeneity, as measured by the coefficient of variation, i.e., the standard deviation divided by the mean, is higher for the productivity measures than it is for the value added to output ratio. In both datasets, the standard deviation for the latter variable is smaller than the mean, while it is larger than the mean for the output or value added per worker measures. This is why we will focus on productivity rather than value added to output (upgrading) in the regression analysis. We also note that most measures have positive skewness, which indicates that a relatively large part of the observations is found to the right of the mean value. Only value added to output in the IMMEX dataset has negative skewness.

Table (6. 4): Basic Statistics for the Entire Sample (between Firms and Over Time), Maquiladora (1990-2006) and IMMEX (2008-2014) Firm-Level Datasets, All Years and All Manufacturing Sectors (Shares and Constant Mexican Pesos of 2008).

Maquiladora	**Mean**	**Std. Deviation**	**Variance**	**Skewness**	**Kurtosis**	**Min.**	**Max.**	**Obs.**
Value added to output ratio	0.4	0.3	0.1	1	4.7	0.0	2.2	34,728
Value added per worker	137	175	30,646	16	488	-10	9,090	34,728
Output per worker	624	1,491	2,222,947	25	1,109	2	96,849	34,728
IMMEX	**Mean**	**Std. Deviation**	**Variance**	**Skewness**	**Kurtosis**	**Min.**	**Max.**	**Obs.**
Value added to Output ratio	0.8	0.3	0.1	-0.5	2.5	0.0	1.3	34,948
Value added per worker	776	1,852	3,430,753	10	164	0.0	52,851	34,948
Output per worker	1,226	2,889	8,343,702	10	180	0.0	89,488	34,948

Source: Author's calculation based on INEGI's EMIME and IMMEX firm-level datasets.
Notes: for the case of IMMEX the observations corresponding to 2007 (July 2007 to December 207) have been here dropped. Similarly, IMMEX firms reporting negative gross value added for at least one year of observation have been here dropped.

One important thing to mention is the fact that there were some firms with negative gross value added, both in the Maquiladora and the IMMEX dataset. For the case of the Maquiladora firm-level dataset, only 2 firms (3 observations) presented negative gross value added (one firm in the textile sector for two consecutive years and, other firm in the chemical sector for only year). We decided to keep these in all of our calculations. However, in the IMMEX dataset, 404 firms presented negative gross value added in at least one year of observation. In total, there were 638 observations with negative value added (out of 2,357 total observations for 404 firms).

In line with our methodology described above, gross value added for IMMEX firms was calculated by subtracting its total domestic intermediate consumption from the total income obtained by a given firm. Thus, at the firm-level, negative gross value added could be obtained in a given year because (1) a given IMMEX firm reported a higher level of domestic intermediate inputs than its corresponding level for total income or, (2) a given IMMEX firm reported domestic intermediate consumption but without providing information for total income.

Since the presence of negative gross value added observations is mostly seen in the IMMEX dataset, and very rarely in the EMIME dataset, we infer that the reason for these negative observations is related to the new type of exporting firms included in the IMMEX framework and IMMEX dataset since 2007. In this regard, we are referring to a type of firm named IMMEX *Controladora*. In line with Chapter 2, IMMEX *Controladora* refers to firms that control and administrate temporary imports from several other firms belonging to the same organization or hierarchical structure. IMMEX *Controladora* is the main representative of these other firms with regard to customs authorities in Mexico. Therefore, a given IMMEX *Controladora* firm could be reporting higher domestic intermediate consumption than total income, because it is jointly reporting the value of domestic inputs used and total income obtained by a variety of firms that belong to its organization. For instance, an indirect exporter in Mexico (belonging to the organization of a IMMEX *Controladora*) might process domestic and imported intermediate inputs which are later sent to other firms within the same organization for further processing. Such an indirect exporter reports no total income to the IMMEX *Controladora* because its processing operations took place within one and the same organization (no third parties were involved). Alternatively, other indirect exporters in Mexico, registered as IMMEX firms, rather than as part of an IMMEX *Controladora*, might report no income given that their processing of domestic and imported inputs only took place within the same organization.

Therefore, we decided to drop from the IMMEX dataset all those firms that reported at least one year of negative value added. In addition, for the IMMEX dataset, we also dropped all observations for 2007, because for that year information was only reported from July to December of such year. The final IMMEX dataset that we use consists of 34,948 observations, as described in the bottom panel of table 6.4.

6.4.2. Identifying sub-Groups of Firms in the IMMEX Dataset.

The aggregate productivity data of figure 6.1 clearly show that, up to 2007, maquiladora firms are less productive than average Mexican manufacturing. However, the entire IMMEX sample, which includes the maquiladora as well as a broader set of exporting firms, appears as more productive than average manufacturing after 2008. We will investigate this phenomenon by a set of micro-level regressions aimed at explaining labour productivity at the firm level. To obtain insight into the differential performance between maquiladora firms and other exporting firms, it is crucial that we are able to distinguish these two types of firms in the IMMEX dataset.

Our attempt to do this is based on descriptive statistics with regard to imported intermediates and exported production. Table 6.5 provides these descriptives. The two top lines document results for the entire sample. The share of exports in total output is just above 60%. We notice that there are also observations that have zero exports. Since IMMEX firms, by definition, are exporting firms, we must conclude that these are observations that refer to individual years in which the firm does not export, while it exports in other years. This is not completely uncommon, as the 5% percentile value is still at 0 for the entire sample. On the other hand, we also have observations where the entire output is exported, for example at the 90% percentile and up for the total sample. The median for exports is about 10%-points above the mean, indicating a skew towards larger values of this variable. The share of imported intermediates (to total intermediates) is significantly smaller, at about 18% in the total sample. The median value is much lower than this, at only about 2%, indicating a clear skew towards smaller values.

Table (6. 5): Basic Statistics for Exports and Imported Intermediates (between Firms and Over Time), IMMEX (2008-2014), All Years and All Manufacturing Sectors (Shares and Constant Mexican Pesos of 2008)

	Mean	Std. Deviation	5% percentile	10% percentile	Median	90% percentile	95% percentile	Obs.
IMMEX – total								
Exports to gross output	0.619	0.375	0	0.005	0.723	1	1	34,837
Share imported intermediates	0.179	0.257	0	0	0.022	0.611	0.760	34,516
IMMEX – only firms defined as GVC-intensive								
Exports to gross output	0.893	0.167	0.566	0.710	0.962	1	1	8,348
Share imported intermediates	0.156	0.218	0	0	0.059	0.482	0.657	8,253
IMMEX – only firms defined as non-GVC intensive								
Exports to gross output	0.518	0.380	0	0	0.508	1	1	22,146
Share imported intermediates	0.182	0.269	0	0	0.7E-4	0.646	0.780	22,000

Source and notes as described in table 6.4

The traditional image of the maquiladora is a firm that imports (almost) all of intermediates and exports (almost) all of its output. Clearly, the descriptive statistics in table 6.5 show that we have very few observations that adhere to this image. It is especially the import variable that is responsible for this. Only 5% (i.e., about 1,700) of all observations have a larger than 76% share of imported intermediates, and a fair amount of observations (slightly more than 40%) have zero imported intermediates.

Given that we can only find few typical maquiladora firms in the IMMEX dataset, we opt for a slightly different rule for splitting the IMMEX firms. We define one group of firms, which we call GVC intensive IMMEX firms as those firms that export more than 70% of their total output, and import at least some (>0%) of their intermediate goods. We use the first year of observation for each firm to measure this. Firms that do not meet these two criteria in the first year of their existence in the dataset are defined as non-GVC intensive IMMEX firms.

The bottom parts of table 6.5 document descriptive statistics for the GVC-intensive and non-GVC-intensive firms, defined in this way. Clearly, GVC intensive firms score higher on both variables (by definition), but the average for the share of imported intermediates is only about 16% for these firms. Somewhat paradoxically, this share is a bit larger for non-GVC-intensive firms. Obviously, this is caused by the fact that only the first observation of each firm defines its status as either GVC-intensive or non-GVC-intensive. What this ultimately shows, is that this categorization of firms is not static over time, at least not in the IMMEX dataset that we are using. Nevertheless, we proceed to estimate our regression models with this definition in mind. We also experimented with alternative definitions, but we do not document those results.

6.5. Econometric Analysis

6.5.1. Econometric Specification

The econometric specification that will be used starts from two main ideas, which are (1) that the level of productivity depends on the level of a set of explanatory variables, and (2) that productivity growth depends on the level of that same set of explanatory variables. These are alternative but complementary interpretations of the relationship between productivity and its determinants. As an example, think about skills (or educational level) of the workers. On the one hand (our first idea above), a higher skilled worker is likely to be more productive, but we may also expect (our second idea) that a higher skilled worker will be able to learn more efficiently and hence generate a higher amount of productivity growth.

In the econometric specification, both ideas are combined in the form of a so-called Error Correction Model (ECM). ECMs were first proposed by Engle and Granger (1987) and include first differences specifications for the set of independent variables included in the regression, as well as lagged specifications for all dependent and independent regressors. Let us now explain in detail the reasoning behind the ECM.

The first of the two above ideas may be formalized as follows:

$$\ln(Y) = c + a * \ln(X), \qquad (6.7)$$

where Y is the level of labor productivity, and X is the set of independent variables, also specified in levels (as opposed to growth rates). Note that this equation may readily be transformed to first differences, yielding

$$\ln(Y_t) - \ln(Y_{t-1}) = \Delta \ln(Y) = a * [\ln(X_t) - \ln(X_{t-1})] = a\Delta\ln(X) \qquad (6.8)$$

On the other hand, the second idea above can be formalized as follows:

$$\ln(Y_t) - \ln(Y_{t-1}) = \Delta \ln(Y) = d + b * [\ln(X_{t-2})] \qquad (6.9)$$

Note the crucial difference between equations (6.8) and (6.9): (6.8) is specified completely in first differences, while (6.9) only has first differences on the left hand side.

The ECM combines all these approaches in a single estimation. ECMs assume that the first-level specification (equation 6.7) can be regarded as a long run equilibrium. Therefore, the following expected to hold in the long-run:

$$EC \equiv \ln(Y) - c - a * \ln(X) = 0 \qquad (6.10)$$

Equation (6.10) states that equation (6.8) holds exactly in the long run, i.e., that any residuals (or error terms) in equation (6.8) would be zero in the long run. The full ECM specifies that all deviations from equation (6.10) (i.e., from EC = 0) will induce "adjustments" (or "corrections") that will bring the firm back to the equilibrium (EC = 0). This is captured in the following specification:

$$\ln(Y_t) - \ln(Y_{t-1}) = c_0 + a_0 * (\ln(X_t) - \ln(X_{t-1})) + k * EC_{t-1}, \qquad (6.11)$$

with $k < 0$. Note that when the dependent variable is above its equilibrium level, $EC > 0$ will hold. With negative k, this will induce the dependent variable to fall, because then $k * EC < 0$, and the left hand side of equation (6.11) is the change in the dependent variable.

To arrive at a version of the DCM that can easily be estimated, we substitute the definition of EC into equation (6.11) to arrive at

$$\Delta \ln(Y_t) = \ln(Y_t) - \ln(Y_{t-1}) = c_0 + a_0 * \Delta \ln(X_t) + k * [\ln(Y_{t-2}) - c - a * \ln(X_{t-2})] =$$

$$c_0 - kc + a_0 * \Delta \ln(X_t) + k \ln(Y_{t-2}) - ak * \ln(X_{t-2}) \qquad (6.12)$$

In this equation, the change of labor productivity depends on the change in the independent variables (first idea above), but also on the level of the independent variables (second idea above), and in addition it depends on the lagged value of itself[48]. Econometric estimation of the model can be implemented as follows

$$\Delta \ln(Y_t) = c_1 + a_0 * \Delta \ln(X_t) + k \ln(Y_{t-2}) + a_1 * \ln(X_{t-2}) \qquad (6.13)$$

This will directly provide an estimate of the error correction parameter k, whereas the long-run elasticities a can readily be obtained from the estimated parameters k and a_1 ($a = - a_1/k$). Hence, the estimation of equation (6.13) both yields information on short run adjustments (parameters k and a_0) and long-run equilibrium (parameters a).

6.5.2. Selection of Explanatory Variables

Our main interest is to find indications of the micro-level variables that may explain the strikingly different labour productivity performance between maquiladora firms and non-maquiladora firms that still export. Our aggregate analysis suggests that the differences between these two groups of firms are large. Firm-level variations in our preferred measure of labor productivity for Maquiladora/IMMEX firms, i.e. value added per worker will be the dependent variable in the analysis. This section will present the operationalization of the independent variables, their expected sign and impact on labor productivity, as well as the specific data we use both for the case of EMIME and IMMEX. Table A6.3 in the appendix indicates specific details about the operationalization of each variable. Also, table A6.4 in the appendix presents basic statistics for our set of dependent and independent variables.

The explanatory variables that will be used in the regressions are as follows: (1) economies of scale; (2) capital deepening; (3) use of imported intermediates; (4) the quality of labor force, and; (5) export intensity. Let us now discuss each factor in detail.

Regarding the first factor, according to Verdoorn (1949) higher gross output can lead to higher productivity in a given firm due to the existence of dynamic economies of scale. To capture this effect, we include the logarithm of firm-level output produced by a given exporting firm (*ln_output*). The traditional Verdoorn effect is a dynamic effect, i.e., we

[48] t-2 is included in formula 6.12 as it indicates the lagged value of the initial lagged value (t-1) from the independent variables that were included in the first set of regressions. A second lagged of the initial lagged value is here included to further assess the existence of a long run relationship between the dependent and independent variables

can expect growth of output to lead to growth of productivity. But note that the ECM also includes a static scale effect, in which the level of output may lead to growth of productivity. We also include the size of the firm in terms of employees as an explanatory variable related to scale. Note that this is the variable that appears in the denominator of the dependent variable (which is value added divided by number of employees). We include this variable mainly as a control to account for the negative effect that firm size may have through this channel.

As for the second variable, an increase in the amount of capital per worker (i.e., capital deepening) will lead to rising firm-level productivity. According to McEachern (2014), as capital per worker increases, output per worker will also increase but, at a diminishing rate given the law of diminishing returns to capital. As mentioned in previous sections, in the case of Maquiladora and IMMEX firms, there is no available information on the firm-level imports of machinery and equipment. However, variables related to firm-level investment are available for both datasets (domestic purchases of machinery and equipment for Maquiladora and, payments for the rent of movable assets in the case of IMMEX). Thus, to account for the impact of capital deepening in labor productivity, we will rely on the investment variables to construct our own proxy for capital deepening. We constructed a capital stock following the Perpetual Inventory Method (PIM). Initial capital stocks (which are required for computing PIM) were constructed following Timmer (1999) (see table A6.3 for details). With this information, we constructed the firm-level ratio of capital stock to labor (*capital_labor*). Labor working with higher capital levels should induce higher gross value added per worker. So, we expect the variable *capital_labor* to have a positive impact on labor productivity.

Regarding the impact of foreign intermediate inputs on firm level productivity, we identified mixed empirical evidence. On the one hand, by using firm-level data for Chilean manufacturing, Kasahara and Rodrigue (2008) find evidence that imported intermediates improve productivity. In their view, a firm can immediately increase productivity by switching from being a non-importer to an importer of foreign intermediates. In general, the argument here is that a high ratio of imported inputs could provide opportunities for learning especially if combined with a highly educated working force. On the other hand, other studies indicate that imported inputs do not necessarily lead to rising productivity. For instance, on his study of Colombian firms, Van Biesebroeck (2003) finds that importing inputs has a negative effect on productivity growth. According to this author, many technologies used in developing economies (that are created in advanced countries) are inappropriate for the local mix of skills. Thus, having access to new technologies (or highly complex intermediate inputs) will not suffice to increase productivity. We therefore do not formulate exact expectations for the variable on foreign inputs, which we define as the ratio of imported intermediate inputs to total intermediate consumption *(imp_interm*). Either a positive or a negative sign is possible on this variable.

As for the fourth factor, it can be argued that a well-educated work force contributes to a better use of available technologies. We will construct three different proxies to account for the impact of the quality of labor force in firm-level labor productivity. In line with Montes-Rojas and Santamaria (2007), our first proxy for the quality of labor will be a ratio of the blue collar to white collar working hours (*blue_white_hours*). If a given firm decides to increase its use of low-qualified labor and reduce the share of its highly-qualified labor, labor productivity level should decrease. Therefore, for this variable (*blue_white_hours*), we expect a negative impact on labor productivity. Following the same stream of ideas, Haltiwanger et al. (1999) states that firms that with higher fractions of educated workforce are prone to higher productivity levels. Also, these authors empirically confirm the need to add workforce composition variables in to firm-level productivity regressions given that those variables add significant explanatory power. Considering these arguments from Haltiwanger et al. (1999), the second proxy for the quality of labor will be the share of technicians in total employment (*tech_empleo*). The reasoning here is that a higher use of technicians with respect to total labor in the firm should be reflected in rising productivity. Finally, also considering the arguments from the latter authors, our third proxy for the quality of labor is a workforce composition variable which is the ratio of average firm-level remuneration to total firm-level labor (*labor_comp*). A higher quality of labor in an exporting firm should be reflected in higher wages, which is why this variable may be interpreted as an indicator for the quality of labor. In our expectation, higher values of the labor compensation variable will be associated with higher productivity levels.

With regard to our fifth independent variable, Castellaci (2002) finds that productivity growth is positively influenced by firm's export intensity in his econometric analysis of Italian manufacturing firms from 1989 to 1994. Following Castellaci (2002), we will measure export intensity as the share of foreign sales on total sales (*export_int*). Nevertheless, a distinction between foreign sales and total sales is only available for the case of the IMMEX and not for the Maquiladora panel dataset. Thus, our econometric analysis can only include the export intensity variable for the analysis of productivity of IMMEX.

Finally, as further control variables, we also include the firm's age (in years, and also including a squared version).

6.5.3. Econometric Results

Before estimating the full ECM, we attempt to estimate the long-run relation directly by adding an error term to equation (6.7). This equation is estimated by using fixed effects.[49] Results are presented in table 6.6, both for EMIME (Maquiladora) and IMMEX. For IMMEX, we present results for the sample of firms that is defined as GVC-intensive, and those defined as non-GVC-intensive. In general, our econometric results in this table differ more between the two datasets than between the GVC-intensive and non-GVC-intensive firms within IMMEX.

We start with scale effects, which are captured by the size variable (incl. the square) and the ln_output variable. Both size variables are significant in the EMIME dataset and in IMMEX-GVC-intensive regressions. The quadratic term is not significant in the IMMEX-non-GVC-intensive regression. The positive sign on the squared size term indicates a

[49] For every specification, Hausman tests (not reported here) prefer fixed effects over a random effects specification.

minimum efficient size, but this minimum lies far outside the relevant range of employee size. Thus, the regressions all show a negative effect of size in terms of employees on labour productivity. This seems mainly the result of the fact that the number of employees occurs in the denominator of the dependent variable.

Table (6. 6): Econometric Results for IMMEX, Fixed effects Dependent variable: Logarithm of Firm-Level Labor Productivity.

	EMIME (maquiladora)	IMMEX (GVC-intensive)	IMMEX (non-GVC-intensive)
ln_size	-0.028***	-1.050***	-1.010***
	(0.07)	(0.11)	(0.06)
ln_size_squared	4.47E-4***	7.37E-3**	7.38E-4
	(0.00)	(0.00)	(0.01)
ln_age	0.021*	0.118***	0.173***
	(0.01)	(0.02)	(0.02)
ln_age_squared	-0.082***	-0.077***	-0.082***
	(0.00)	(0.01)	(0.01)
ln_imp_interm	-0.044***	-0.016***	-0.019***
	(0.00)	(0.00)	(0.00)
ln_export_int		0.251***	0.078***
		(0.01)	(0.01)
ln_output	0.261***	0.972***	0.981***
	(0.01)	(0.01)	(0.01)
ln_capital_labor	0.302***	-0.008	-0.015
	(0.07)	(0.10)	(0.03)
ln_blue_white_hours	-0.013	-0.023	-0.013
	(0.01)	(0.01)	(0.02)
ln_tech_empleo	0.024**	-0.016	0.018
	(0.01)	(0.01)	(0.02)
ln_labor_comp	0.617***	0.044**	0.012
	(0.01)	(0.01)	(0.01)
ln_constant	-3.409***	0.087	-0.019
	(1.03)	(1.83)	(0.57)
r-sqr	0.659	0.834	0.628
dfres	13,784	2,756	4,015
bic	-9,823.7	-3,771.8	-1,797.9
obs	17,494	3,824	5,668
No. firms	3,700	1,057	1,642

Notes: * p<0.05, ** p<0.01, *** p<0.001. Robust standard errors are shown in parentheses.

On the other hand, our proxy for the impact of economies of scale (*ln_output)* has a positive and statistically significant impact on labor productivity. This effect is stronger in IMMEX than in EMIME, and it does not differ much between the two types of IMMEX firms. Higher output in Maquiladora and IMMEX firm will induce higher productivity levels as expected. Note that in this specification, the scale effect is purely static.

With respect to capital deepening (higher capital per worker, capital_labor variable), we find a positive and significant effect only in EMIME, indicating that here more capital per worker in exporting firms is positively associated with productivity levels. The variable is not significant in the IMMEX regressions.

For imported intermediates, we observe that a higher value leads to lower labor productivity levels for all exporting firms in Mexico (a significant and negative sign). This negative coefficient supports the idea that exporting firms usually import inputs with high technological content produced by more efficient suppliers located elsewhere, and that such imports lower their own productivity, supporting the earlier finding by Van Biesebroeck (2003). This effect is weaker in the IMMEX dataset, where it does not differ much between the two groups of firms.

Of the three proxies for the quality of labor, two are significant for EMIME, and only one for IMMEX. We also ran regressions with just one of these proxies included at the time, and the results do not differ much from what is documented here. The blue to white collar ratio is not significant. For the second proxy for the quality of labor (*tech_empleo*), we observe that increasing the share of highly skilled labor in total labor will be positively associated with higher productivity levels at exporting firms, but only in the EMIME dataset. The third proxy for the quality of labor (*labor_comp*) is positive and significant, i.e., higher expenditures on labor are associated with higher productivity. This positive effect is found for the EMIME dataset, where it is strong, and also for the IMMEX group of firms defined as GVC-intensive. It is not significant for IMMEX-non-GVC-intensive firms. Finally, for the specific case of IMMEX firms (we do not have this variable for EMIME firms), we find a positive and statistically significant coefficient of the variable *export_int*, indicating that the higher exports, the higher productivity. This effect is much stronger for the GVC-intensive firms.

For our control variable age and age squared, both variables are significant in all three regressions. The negative sign on age squared indicates a maximum in the age – productivity relationship. This maximum lies just beyond one (to be precise at 1.14) year for EMIME, which indicates that the effect of age is really negative. For IMMEX-GVC-intensive, the maximum lies at 2.2 years, and for IMMEX-non-GVC-itensive, it lies at 2.9 years, also indicating mostly a negative relationship between age and productivity.

We now proceed to present results for the full ECM specification. Table 6.7 presents our error correction model estimation for Maquiladora and IMMEX. We find a significant and negative sign of the error correction term (this is the coefficient on the lagged dependent variable, labeled *ln_labour_prod* in the table) for EMIME and IMMEX-GVC-intensive firms. This confirms the relevance of the error-correction model for these datasets. However, the error correction coefficient is not significant (and positive) for the non-GVC-intensive group in IMMEX. This points to a first and fundamental difference between the two groups of IMMEX firms. One group, the GVC-intensive group, has a long-run equilibrium productivity level to which it adjusts, while the productivity dynamics in the non-GVC-intensive group are influenced mostly by shorter-run dynamics. In EMIME, the adjustment speed is about twice (20%) that of the GVC-intensive IMMEX firms (11%).

Table (6. 7): Error Correction Model Estimation for Maquiladora and IMMEX

	EMIME (maquiladora)	IMMEX (GVC-intensive)	IMMEX (non-GVC-intensive)
Δln_size	-0.962**	20.466	-1.043**
	(0.30)	(32.87)	(0.36)
Δln_size_squared	-0.004	-0.008	-0.020
	(0.00)	(0.01)	(0.01)
Δln_age	0.122	92.836**	173.447***
	(2.47)	(34.50)	(29.27)
Δln_age_squared	-0.437	-101.329	-165.751***
	(0.65)	(30.68)	(24.95)
Δln_imp_interm	-0.040***	-0.007	-0.026**
	(0.01)	(0.01)	(0.01)
Δln_export_int		0.84***	0.066***
		(0.04)	(0.01)
Δln_output	0.203***	1.043***	1.020***
	(0.01)	(0.02)	(0.02)
Δln_capital_labor	0.705*	21.349	0.224
	(0.30)	(32.87)	(0.34)
Δln_blue_white_collar	0.004	0.012	0.033
	(0.01)	(0.03)	(0.03)
Δln_tech_empleo	0.009	-0.012	0.015
	(0.01)	(0.03)	(0.03)
Δln_labor_comp	0.719***	0.019	0.025
	(0.01)	(0.04)	(0.02)
ln_labour_prod (*t*-2)	-0.202***	-0.111*	0.030
	(0.01)	(0.04)	(0.03)
ln_size (*t*-2)	-0.182	-15.386	-0.288
	(0.13)	(15.02)	(0.16)
ln_size_squared (*t*-2)	0.001	0.006	0.023
	(0.00)	(0.01)	(0.16)
ln_age (*t*-2)	0.038	20.493**	38.243***
	(0.48)	(7.05)	(6.29)
ln_age_squared (*t*-2)	0.009	-11.014**	-16.570***
	(0.10)	(3.38)	(2.52)
ln_imp_interm (*t*-2)	-0.008	-0.016	0.000
	(0.01)	(0.01)	(0.01)
ln_output (*t*-2)	0.058***	0.155**	0.051
	(0.01)	(0.05)	(0.04)
ln_capital_labor (*t*-2)	-0.086	-15.144	0.036
	(0.13)	(15.03)	(0.11)
ln_blue_white_collars (*t*-2)	-0.007	0.002	0.014
	(0.01)	(0.03)	(0.03)
ln_tech_empleo (*t*-2)	-0.010	-0.044	-0.032
	(0.01)	(0.03)	(0.04)
ln_labor_comp (*t*-2)	0.127***	-0.002	-0.059
	(0.01)	(0.04	(0.03)
constant	1.138	315.891	49.819***
	(2.31)	(297.31)	(7.48)
r-sqr	0.788	0.777	0.592
dfres	8,012	1,209	1,861
bic	-8,012.6	-782.2	148.9
obs	10,530	1,767	2,686
No. firms	2,497	535	802

Notes: * p<0.05, ** p<0.01, *** p<0.001. Robust standard errors are shown in parentheses

In the EMIME dataset, the scale (ln_output) and labour composition have positive and significant long-run elasticities for the dependent variable labour productivity. In the

GVC-intensive IMMEX group, scale (ln_output) also has a long-run positive elasticity, and the effect is stronger than in EMIME. For GVC-intensive IMMEX firms, age also has a significant long-run elasticity. With the squared age term negative, this long-run relationship has a maximum, which lies at about 2.5 years.

Scale effects (ln_output) also have a significant and positive short-run effect in all three regressions. This effect if stronger in both IMMEX regressions. Export intensity never has a significant long-run effect, but has a positive short-run effect for the IMMEX firms. This effect is much stronger for GVC-intensive IMMEX firms. GVC-intensive IMMEX firms do not have a significant short-run effect of imported intermediate, but this effect is negative for EMIME and non-GVC intensive IMMEX firms.

6.6. Conclusions.

This chapter studied the micro and macro foundations of labor productivity performance in the export sector in Mexico. We also aimed to compare the aggregate performance of the export sector and that of domestic manufacturing and the ways in which they affect total manufacturing productivity. To this end, this research relied on different sources of information that included aggregate and firm-level information for roughly 24 years. It remains to summarize our general findings.

Dictated by the available data, we use a number of different definitions of the exporting sector in Mexican manufacturing. Up to 2007, the available data on exporting firms are for the so-called maquiladora firms, which are firms that export (almost) all of their output and import (almost) all of their intermediates. They are assembly firms working mostly for the U.S. market. From 2008 to 2014, we have data on a broader set of exporting firms, many of which were not in the maquiladora dataset before 2007. As we show, many of these firms do not import any intermediate goods at all. Within this post-2007 sample, we define two types of firms: those that are GVC-intensive and those that are not GVC-intensive. Note that the pre-2007 maquiladora firms and the post-2007 GVC-intensive firms are not identical. Ideally, we would have liked to define these groups in a much more similar way, but the data do not permit this.

Our results on aggregate and sectoral data break total productivity growth in Mexican manufacturing down into 4 factors: (1) changes of gross export per worker in the export sector; (2) changes of the value added to output ratio at the export sector; (3) changes in the share of employment in the export sector, and; (4) change of labor productivity in domestic manufacturing. Here, we empirically observe that labor productivity in domestic manufacturing (i.e., the fourth factor) drives most of the change in productivity for total manufacturing. Maquiladora firms (pre-2007) have lower labour productivity levels than domestic manufacturing firms, which implies that their rise in terms of employment share has a negative effect on overall productivity (factor 3). We also find that changes in the value added to gross output ratio (which we can consider as upgrading) are mostly negative in the maquiladora sector, and hence influence productivity negatively (factor 2). The positive impact of maquiladora on overall productivity comes from factor 1, the intrinsic productivity growth of these firms, which is positive. After 2007, productivity growth does not differ much between exporting firms (now defined in a different way) and domestic firms.

This part of our analysis leads to the conclusion that the impact of the Mexican maquiladora sector is mostly in terms of absorbing large amounts of workers that would otherwise be employed in sectors with lower productivity (e.g., agriculture). The maquiladora is not a particularly dynamic sector, and is not even highly productive when compared to domestic manufacturing. But it still had an impact on poverty and income of a large amount of workers, by the sheer increase in its size over a few decades.

Given the positive (but still limited) contribution of labor productivity growth in the export sector at the aggregate level, and the relatively large variation of labour productivity levels between firms in the exporting sector, our research then proceeded to econometrically explain the sources of firm-level variation in productivity levels and productivity growth. Capital deepening, economies of scale, higher shares of highly-skilled workers in total employment, as well as changes in the composition of labor (reflecting lower use of low-skilled workers), export orientation of firms, and the share of imported intermediates were used as explanatory variables. We estimated a fixed effects model for the level of labour productivity, and an error correction model for the change of the labour productivity.

We find differences in the results between different groups of firms. The error correction model applies to the maquiladora firms of the EMIME database (which runs up to 2007) and to GVC-intensive firms from the IMMEX data database (which starts in 2008). Non-GVC intensive firms in the IMMEX database do not show an error correction mechanism in which productivity adjusts to a long-run level determined by the explanatory variables. In general, we find that the export-orientation variable and the scale variable show the strongest productivity effects. The share of imported intermediates has a negative correlation to productivity and productivity growth, but not so in the GVC-intensive firms of the IMMEX database.

Overall, we see strong evidence that there are differences between GVC-intensive and non-GVC-intensive firms in terms of what determines productivity and its growth rate. But we cannot trace this to the extent we would like, because the microeconomic databases that are available do not allow us to identify the pure maquiladora firms in the period after 2007, and we do not have any information on exporting firms that are not maquiladora before 2007. Even better databases with a larger variety of firms would enable further research that can enlighten the recent role of the maquiladora in Mexican manufacturing.

Appendix A6.1

Table. A61.1. Gross Output: Maquiladora (1990-2006) and IMMEX (2007-2014). Millions of Mexican Pesos (Constant Prices of 2008)

Year	Food	Textiles	Shoes/ Leather	Wood	Chemicals	Transport	Machinery	Electrical E.	Other M.	Services	Total
1990	4	11	2	11	3	73	43	57	30	5	239
1991	4	13	2	14	4	63	45	58	34	5	241
1992	4	14	2	14	5	72	48	63	30	6	259
1993	4	18	2	17	7	86	52	77	31	7	301
1994	3	22	3	20	7	90	62	94	37	7	344
1995	4	36	3	27	8	79	78	126	48	9	417
1996	5	48	4	28	9	101	104	147	59	10	517
1997	5	59	4	27	11	112	133	168	75	19	613
1998	5	72	4	31	14	116	144	192	80	23	681
1999	5	81	5	34	15	133	145	225	92	28	763
2000	5	89	5	38	18	155	143	280	102	27	863
2001	5	90	5	38	17	157	123	247	102	28	813
2002	5	84	4	39	19	176	140	229	107	28	833
2003	8	88	4	39	17	182	168	247	112	30	896
2004	8	91	4	44	18	193	185	300	129	34	1,006
2005	9	84	3	45	21	201	245	304	145	31	1,089
2006	12	77	3	51	28	223	284	353	152	36	1,218
Year	Food	Textiles	Shoes/ Leather	Wood	Chemicals	Transport	Machinery	Electrical E.	Other M.	Services*	Total
2007a	150	52	7	22	222	604	237	424	63	n.a.	1,780
2008	294	101	12	44	401	1,159	527	841	121	n.a.	3,500
2009	293	96	13	47	501	947	369	672	115	n.a.	3,052
2010	277	95	13	55	434	1,187	469	804	119	n.a.	3,453
2011	276	95	17	56	372	1,385	531	823	127	n.a.	3,681
2012	301	92	19	61	379	1,621	573	744	128	n.a.	3,918
2013	294	88	19	67	432	1,663	599	759	135	n.a.	4,058
2014	309	87	20	71	452	1,988	642	857	169	n.a.	4,595

Source: Author's calculation using data from INEGI's National Accounting System (1990-2014), EMIME (1990-2006) and, IMMEX (July 2007-2014). For 2007, information was only available from July to December.

* Aggregate data for IMMEX services can be found under the category of "non-manufacturing establishments". Nonetheless, such information was not available at the firm level, Thus, for the sake of consistency, we decided to omit that information at the aggregate level.

Table. A6.1.2. Gross Output: Domestic Economy of Mexico. Millions of Mexican Pesos (Constant Prices of 2008)

Year	Food	Textiles	Shoes/ Leather	Wood	Chemicals	Transport	Machinery	Electrical E.	Other M.	Services	Total
1990	986	153	37	192	523	248	443	86	167	488	3,324
1991	982	158	41	193	517	252	410	82	173	545	3,353
1992	987	154	40	201	513	277	358	80	203	609	3,423
1993	1,012	152	39	195	520	256	324	82	205	658	3,444
1994	1,030	151	38	207	552	279	339	93	200	683	3,572
1995	1,025	149	35	218	541	230	366	126	164	622	3,476
1996	1,075	170	40	220	588	303	396	139	185	653	3,769
1997	1,089	176	42	219	638	343	433	172	197	719	4,028
1998	1,142	182	42	222	667	384	474	199	207	728	4,247
1999	1,134	185	42	222	658	422	426	212	218	768	4,287
2000	1,152	200	40	227	712	534	483	255	221	791	4,615
2001	1,149	166	37	205	667	527	436	207	214	839	4,448
2002	1,151	158	35	194	655	533	392	217	204	828	4,367
2003	1,173	144	34	191	680	502	385	211	197	824	4,339
2004	1,192	145	33	200	675	518	483	231	194	832	4,503
2005	1,382	145	44	170	976	627	505	988	279	882	5,997
2006	1,410	153	46	176	1,033	720	555	1,236	291	921	6,540
Year	Food	Textiles	Shoes/ Leather	Wood	Chemicals	Transport	Machinery	Electrical E.	Other M.	Services*	Total
2007a	1,361	173	43	212	987	616	696	1,331	377	n.a.	5,795
2008	1,290	120	36	198	850	278	569	902	289	n.a.	4,532
2009	1,290	118	35	192	958	183	502	656	240	n.a.	4,173
2010	1,320	130	38	201	734	296	602	884	271	n.a.	4,476
2011	1,347	118	34	199	591	333	599	1,053	280	n.a.	4,553
2012	1,353	122	32	205	519	321	588	1,295	285	n.a.	4,722
2013	1,385	125	33	202	663	458	598	1,492	274	n.a.	5,230
2014	1,384	123	31	204	624	343	612	1,584	261	n.a.	5,167

Source and notes as described in table A61.1.

Table.A6.1.3. Gross Output: Total Economy of Mexico. Millions of Mexican Pesos (Constant prices of 2008)

Year	Food	Textiles	Shoes/ Leather	Wood	Chemicals	Transport	Machinery	Electrical E.	Other M.	Services	Total
1990	990	165	40	202	527	320	487	143	197	493	3,564
1991	986	170	43	207	521	315	455	139	208	550	3,594
1992	991	168	43	216	517	349	406	143	233	615	3,681
1993	1,016	170	42	212	527	342	376	159	236	666	3,745
1994	1,033	173	41	227	559	369	401	187	236	689	3,916
1995	1,029	185	38	245	548	309	444	252	213	630	3,893
1996	1,079	218	44	249	598	404	500	286	245	664	4,286
1997	1,093	235	46	247	649	455	566	340	272	738	4,641
1998	1,147	254	46	253	680	500	618	391	287	751	4,928
1999	1,139	267	47	255	673	555	571	437	310	796	5,050
2000	1,157	289	45	266	729	689	626	535	323	818	5,478
2001	1,154	256	42	244	685	685	559	454	316	867	5,261
2002	1,156	242	39	233	675	709	532	446	312	856	5,200
2003	1,181	232	38	230	697	684	553	458	309	854	5,235
2004	1,200	236	37	243	694	711	669	530	323	866	5,508
2005	1,391	229	47	216	997	828	749	1,292	424	913	7,086
2006	1,422	230	49	227	1,060	943	839	1,589	443	957	7,758
Year	Food	Textiles	Shoes/Leather	Wood	Chemicals	Transport	Machinery	Electrical E.	Other M.	Services*	Total
2007[a]	1,511	225	50	233	1,209	1,220	933	1,755	439	n.a.	7,575
2008	1,584	221	49	242	1,251	1,437	1,095	1,743	409	n.a.	8,032
2009	1,582	213	48	239	1,459	1,129	872	1,328	355	n.a.	7,225
2010	1,597	225	52	255	1,168	1,483	1,071	1,687	390	n.a.	7,929
2011	1,623	212	51	255	962	1,718	1,130	1,877	407	n.a.	8,234
2012	1,654	214	52	266	899	1,942	1,161	2,039	414	n.a.	8,640
2013	1,680	213	51	270	1,095	2,121	1,197	2,251	410	n.a.	9,288
2014	1,693	210	51	275	1,076	2,331	1,254	2,441	430	n.a.	9,763

Source and notes as described in table A61.1.

Table A6.1.4. Gross Value Added: Maquiladora (1990-2006) and IMMEX (2007 -2014). Millions of Mexican Pesos (Constant Prices of 2008)

Year	Food	Textiles	Shoes/ Leather	Wood	Chemicals	Transport	Machinery	Electrical E.	Other M.	Services	Total
1990	1	3	1	3	1	12	9	19	8	2	58
1991	1	3	1	3	1	15	9	21	8	2	65
1992	1	4	1	3	1	16	9	20	7	2	65
1993	1	4	1	3	1	13	8	19	7	2	60
1994	1	5	1	4	1	14	9	21	7	2	64
1995	1	9	1	5	2	17	13	30	11	3	91
1996	2	14	1	7	3	24	17	42	13	4	124
1997	2	16	1	7	2	16	18	39	14	4	120
1998	1	18	1	8	3	18	17	43	16	4	130
1999	1	21	1	9	4	22	19	51	19	5	153
2000	1	22	1	10	4	24	20	56	19	5	162
2001	1	23	1	10	3	24	18	54	20	5	159
2002	1	22	1	9	3	29	18	46	19	4	153
2003	2	20	1	9	3	34	19	47	20	5	160
2004	2	20	1	9	3	37	20	48	21	6	167
2005	2	19	1	8	4	38	24	50	23	6	176
2006	2	17	1	9	5	40	28	55	25	7	189
Year	Food	Textiles	Shoes/ Leather	Wood	Chemicals	Transport	Machinery	Electrical E.	Other M.	Services*	Total
2007a	83	25	3	10	109	309	123	82	22	n.a.	768
2008	161	47	5	21	213	597	311	162	40	n.a.	1,557
2009	169	46	6	23	330	477	218	146	42	n.a.	1,457
2010	165	48	7	26	209	622	279	164	46	n.a.	1,566
2011	160	45	7	25	230	721	305	158	45	n.a.	1,697
2012	159	42	7	27	177	815	295	141	44	n.a.	1,705
2013	178	41	7	30	325	876	341	148	44	n.a.	1,991
2014	177	41	8	32	205	921	340	157	47	n.a.	1,928

Source and notes as described in table A61.1.

Table. A6.1.5. Gross Value Added: Domestic Economy of Mexico. Millions of Mexican Pesos (Constant Prices of 2008)

Year	Food	Textiles	Shoes/ Leather	Wood	Chemicals	Transport	Machinery	Electrical E.	Other M.	Services	Total
1990	390	72	16	98	190	73	178	36	113	563	1,729
1991	468	75	18	97	212	114	182	37	118	631	1,951
1992	428	73	17	95	202	126	164	36	122	646	1,908
1993	359	63	15	84	175	82	137	34	113	640	1,703
1994	353	59	14	84	171	85	137	37	113	675	1,727
1995	450	69	17	104	259	132	196	48	122	829	2,225
1996	574	94	22	123	323	192	272	72	154	951	2,777
1997	503	84	19	115	242	122	243	69	122	786	2,305
1998	446	75	17	110	227	131	231	64	125	795	2,221
1999	483	68	17	103	236	143	224	55	129	824	2,282
2000	494	65	15	94	240	146	208	58	125	774	2,220
2001	457	54	13	84	218	126	167	47	115	772	2,051
2002	448	51	13	76	211	135	156	43	109	746	1,986
2003	444	43	12	71	212	140	151	40	114	799	2,026
2004	458	46	13	73	209	158	194	44	110	797	2,101
2005	529	60	17	58	300	174	222	95	144	811	2,411
2006	541	65	18	60	423	198	244	109	151	844	2,653
Year	Food	Textiles	Shoes/ Leather	Wood	Chemicals	Transport	Machinery	Electrical E.	Other M.	Services*	Total
2007a	541	70	16	70	373	193	239	97	165	n.a.	1,764
2008	536	51	14	67	373	128	220	17	135	n.a.	1,542
2009	534	47	13	66	561	91	154	20	134	n.a.	1,621
2010	542	54	14	69	364	145	198	20	138	n.a.	1,545
2011	555	57	14	70	353	180	218	29	144	n.a.	1,620
2012	566	60	14	74	306	213	230	40	147	n.a.	1,650
2013	567	59	13	73	436	220	217	33	131	n.a.	1,748
2014	573	59	12	75	287	256	236	42	135	n.a.	1,675

Source and notes as described in table A61.1.

Table A6.1.6. Gross Value Added: Total Economy of Mexico. Millions of Mexican Pesos (Constant prices of 2008)

Year	Food	Textiles	Shoes/ Leather	Wood	Chemicals	Transport	Machinery	Electrical E.	Other M.	Services	Total
1990	392	75	17	101	190	85	186	55	120	565	1,787
1991	469	79	18	100	213	129	191	58	126	633	2,016
1992	429	77	18	98	203	142	173	56	129	648	1,973
1993	360	68	16	87	176	96	145	53	120	643	1,763
1994	354	64	14	88	172	98	146	58	120	677	1,791
1995	451	78	18	109	261	148	209	78	132	831	2,315
1996	576	107	23	130	325	216	288	114	168	955	2,902
1997	504	101	20	122	244	139	260	108	136	790	2,425
1998	448	93	18	117	230	150	248	107	141	799	2,351
1999	485	89	17	113	240	164	243	107	148	830	2,435
2000	496	87	16	105	244	170	228	114	144	779	2,382
2001	458	77	14	93	221	150	185	100	135	778	2,210
2002	450	72	14	85	214	164	175	89	127	750	2,139
2003	446	64	13	80	215	174	170	87	134	804	2,186
2004	459	66	13	82	212	195	214	92	131	803	2,268
2005	531	79	18	66	305	212	246	146	167	817	2,586
2006	543	83	18	69	429	238	272	163	176	851	2,842
Year	Food	Textiles	Shoes/ Leather	Wood	Chemicals	Transport	Machinery	Electrical E.	Other M.	Services*	Total
2007[a]	624	95	20	80	482	502	362	179	188	n.a.	2,531
2008	697	99	20	88	586	725	530	179	175	n.a.	3,099
2009	703	94	20	90	891	568	371	165	177	n.a.	3,077
2010	706	102	21	96	574	767	478	185	184	n.a.	3,111
2011	714	102	21	96	583	902	524	187	189	n.a.	3,317
2012	724	101	20	101	483	1,029	525	182	191	n.a.	3,355
2013	745	101	20	104	760	1,096	557	181	175	n.a.	3,738
2014	751	100	20	107	491	1,178	576	199	182	n.a.	3,604

Source and notes as described in table A61.1

Table. A6.1.7. Total Employment: Maquiladora (1990-2006) and IMMEX (2007-2014).

Year	Food	Textiles	Shoes/ Leather	Wood	Chemicals	Transport	Machinery	Electrical E.	Other M.	Services	Total
1990	7,428	42,677	7,309	24,208	6,694	106,892	53,268	48,531	58,505	21,672	377,184
1991	9,516	48,759	7,638	27,951	7,943	126,538	54,619	49,473	61,323	25,438	419,198
1992	10,054	57,972	7,666	28,905	9,590	122,543	61,798	56,611	61,015	26,581	442,735
1993	11,836	65,973	7,217	34,739	12,456	124,623	62,791	57,455	69,772	26,522	473,384
1994	7,806	82,513	7,315	33,891	11,718	130,530	72,525	66,554	72,345	25,113	510,310
1995	9,164	107,015	7,460	37,845	13,120	150,327	73,941	66,483	78,469	30,054	573,878
1996	11,255	147,196	7,493	41,343	14,439	161,141	80,956	72,519	96,288	32,324	664,954
1997	12,565	183,241	8,786	45,383	17,453	186,179	97,797	88,570	116,763	36,890	793,627
1998	11,941	219,079	9,309	51,226	20,507	199,910	99,312	88,898	125,441	42,368	867,991
1999	11,038	262,994	8,623	60,017	22,773	216,853	111,219	98,722	154,115	45,086	991,440
2000	10,183	288,966	8,770	62,449	25,365	245,811	117,667	102,810	157,320	49,410	1,068,751
2001	9,798	231,191	6,502	52,238	21,059	218,291	101,621	85,101	138,263	37,294	901,358
2002	9,826	223,210	6,056	52,397	21,731	241,587	111,504	93,536	140,059	36,914	936,820
2003	9,179	195,577	5,741	50,705	21,176	238,577	111,895	94,896	146,277	35,601	909,624
2004	10,533	200,645	4,673	53,329	27,084	249,528	132,523	112,706	163,265	45,377	999,663
2005	10,463	169,677	5,292	56,141	31,051	263,804	140,468	120,771	177,219	47,450	1,022,336
2006	11,008	158,286	5,727	57,540	37,054	268,032	143,291	123,632	182,148	52,989	1,039,707
Year	Food	Textiles	Shoes/Leather	Wood	Chemicals	Transport	Machinery	Electrical E.	Other M.	Services*	Total
2007[a]	144,350	190,114	17,412	36,847	198,697	498,714	205,192	451,617	159,178	n.a.	1,902,121
2008	145,758	175,778	15,356	34,397	186,326	429,664	204,347	398,864	147,692	n.a.	1,738,182
2009	140,473	167,466	16,746	34,596	181,479	412,629	181,651	369,909	140,342	n.a.	1,645,291
2010	138,818	166,926	18,958	40,524	208,984	479,311	212,344	396,449	148,168	n.a.	1,810,482
2011	146,108	149,758	24,120	39,523	219,719	538,021	224,505	376,066	161,294	n.a.	1,879,114
2012	147,813	154,125	25,596	41,203	233,996	605,565	235,655	381,796	166,011	n.a.	1,991,760
2013	154,280	160,804	26,725	44,326	241,073	674,023	250,718	389,286	174,787	n.a.	2,116,022
2014	156,300	155,605	25,302	46,154	255,810	733,900	268,893	414,561	186,340	n.a.	2,242,865

Source and notes as described in table A61.1.

Table. A6.1.8. Total Employment: Domestic Economy of Mexico.

Year	Food	Textiles	Shoes/ Leather	Wood	Chemicals	Transport	Machinery	Electrical E.	Other M.	Services	Total
1990	641,193	527,607	108,353	164,274	393,831	295,150	299,392	269,938	105,012	262,119	3,066,869
1991	655,002	531,034	112,292	163,450	401,902	286,240	303,964	277,555	103,427	276,530	3,111,396
1992	672,345	518,280	107,886	165,263	395,282	345,373	309,747	282,289	117,065	288,452	3,201,982
1993	679,253	515,872	101,163	154,367	383,933	313,157	298,940	292,379	116,148	300,699	3,155,911
1994	667,973	497,454	92,557	151,584	370,978	305,242	290,327	304,284	116,033	314,031	3,110,463
1995	651,170	481,971	83,409	136,668	348,688	294,900	265,478	305,199	112,953	325,229	3,005,665
1996	661,413	548,010	88,708	146,700	365,489	324,289	287,153	348,903	125,557	339,106	3,235,328
1997	667,849	620,088	93,083	156,410	384,328	368,915	325,800	412,902	142,262	349,693	3,521,330
1998	685,584	657,228	90,157	164,165	396,147	409,945	348,241	457,263	150,166	362,446	3,721,342
1999	703,465	704,228	90,313	163,244	400,517	433,794	351,673	492,751	180,000	379,453	3,899,438
2000	701,512	747,547	91,466	168,401	406,227	473,453	354,104	565,180	184,321	395,807	4,088,018
2001	702,600	695,336	82,336	155,406	394,108	447,938	330,890	506,783	166,321	411,302	3,893,020
2002	700,710	616,124	76,063	137,999	378,536	437,731	308,924	427,573	169,026	424,636	3,677,322
2003	700,355	574,582	71,580	133,861	363,082	433,414	291,073	413,958	176,507	443,141	3,601,553
2004	688,085	545,603	69,021	137,417	357,572	436,816	294,772	421,583	194,627	459,740	3,605,236
2005	689,375	522,039	70,754	132,373	348,792	452,265	299,118	425,788	208,157	469,882	3,618,543
2006	698,420	494,193	71,286	132,945	338,216	458,976	312,842	431,272	213,624	500,983	3,652,757
Year	Food	Textiles	Shoes/Leather	Wood	Chemicals	Transport	Machinery	Electrical E.	Other M.	Services*	Total
2007[a]	685,015	460,594	67,799	136,793	330,370	688,303	255,132	622,654	191,748	n.a.	3,438,408
2008	680,465	412,985	62,900	123,341	319,660	603,483	261,367	580,758	181,416	n.a.	3,226,375
2009	677,981	370,092	60,061	119,275	294,002	539,117	230,130	557,312	172,704	n.a.	3,020,674
2010	671,922	370,893	62,215	121,957	297,724	612,158	256,411	590,309	180,531	n.a.	3,164,120
2011	680,815	347,434	61,752	119,013	299,754	685,311	275,841	568,978	195,256	n.a.	3,234,154
2012	688,026	337,135	64,060	116,814	298,990	766,918	282,275	580,217	201,708	n.a.	3,336,143
2013	688,786	341,041	63,794	115,148	289,684	851,831	277,920	586,694	211,149	n.a.	3,426,047
2014	697,855	339,391	63,931	108,854	288,684	925,325	294,577	618,491	222,706	n.a.	3,559,814

Source and notes as described in table A61.1.

Table A6.1.9. Total Employment: Total Economy of Mexico.

Year	Food	Textiles	Shoes/ Leather	Wood	Chemicals	Transport	Machinery	Electrical E.	Other M.	Services	Total
1990	648,621	570,284	115,662	188,482	400,525	402,042	352,660	318,469	163,517	283,791	3,444,053
1991	664,518	579,793	119,930	191,401	409,845	412,778	358,583	327,028	164,750	301,968	3,530,594
1992	682,399	576,252	115,552	194,168	404,872	467,916	371,545	338,900	178,080	315,033	3,644,717
1993	691,089	581,845	108,380	189,106	396,389	437,780	361,731	349,834	185,920	327,221	3,629,295
1994	675,779	579,967	99,872	185,475	382,696	435,772	362,852	370,838	188,378	339,144	3,620,773
1995	660,334	588,986	90,869	174,513	361,808	445,227	339,419	371,682	191,422	355,283	3,579,543
1996	672,668	695,206	96,201	188,043	379,928	485,430	368,109	421,422	221,845	371,430	3,900,282
1997	680,414	803,329	101,869	201,793	401,781	555,094	423,597	501,472	259,025	386,583	4,314,957
1998	697,525	876,307	99,466	215,391	416,654	609,855	447,553	546,161	275,607	404,814	4,589,333
1999	714,503	967,222	98,936	223,261	423,290	650,647	462,892	591,473	334,115	424,539	4,890,878
2000	711,695	1,036,513	100,236	230,850	431,592	719,264	471,771	667,990	341,641	445,217	5,156,769
2001	712,398	926,527	88,838	207,644	415,167	666,229	432,511	591,884	304,584	448,596	4,794,378
2002	710,536	839,334	82,119	190,396	400,267	679,318	420,428	521,109	309,085	461,550	4,614,142
2003	709,534	770,159	77,321	184,566	384,258	671,991	402,968	508,854	322,784	478,742	4,511,177
2004	698,618	746,248	73,694	190,746	384,656	686,344	427,295	534,289	357,892	505,117	4,604,899
2005	699,838	691,716	76,046	188,514	379,843	716,069	439,586	546,559	385,376	517,332	4,640,879
2006	709,428	652,479	77,013	190,485	375,270	727,008	456,133	554,904	395,772	553,972	4,692,464
Year	Food	Textiles	Shoes/ Leather	Wood	Chemicals	Transport	Machinery	Electrical E.	Other M.	Services*	Total
2007[a]	829,365	650,708	85,211	173,640	529,067	1,187,017	460,324	1,074,271	350,926	n.a.	5,340,529
2008	826,223	588,763	78,256	157,738	505,986	1,033,147	465,714	979,622	329,108	n.a.	4,964,557
2009	818,454	537,558	76,807	153,871	475,481	951,746	411,781	927,221	313,046	n.a.	4,665,965
2010	810,740	537,819	81,173	162,481	506,708	1,091,469	468,755	986,758	328,699	n.a.	4,974,602
2011	826,923	497,192	85,872	158,536	519,473	1,223,332	500,346	945,044	356,550	n.a.	5,113,268
2012	835,839	491,260	89,656	158,017	532,986	1,372,483	517,930	962,013	367,719	n.a.	5,327,903
2013	843,066	501,845	90,519	159,474	530,757	1,525,854	528,638	975,980	385,936	n.a.	5,542,069
2014	854,155	494,996	89,233	155,008	544,494	1,659,225	563,470	1,033,052	409,046	n.a.	5,802,679

Source and notes as described in table A61.1.

Table A6.1.10. Labor Productivity: Maquiladora (1990-2006) and IMMEX (2007-2014). Millions of Mexican Pesos (Constant Prices of 2008).

Year	Food	Textiles	Shoes/Leather	Wood	Chemicals	Transport	Machinery	Electrical E.	Other M.	Services	Total
1990	189	68	89	118	94	110	164	399	133	97	154
1991	123	69	80	112	116	120	164	426	134	84	155
1992	115	69	82	108	104	132	149	361	115	87	147
1993	97	65	76	89	93	107	131	331	95	90	126
1994	114	60	75	104	104	104	123	316	103	95	126
1995	141	81	104	134	144	111	175	450	134	97	158
1996	142	92	115	162	179	146	206	576	139	117	187
1997	126	90	90	162	142	88	180	444	119	104	151
1998	114	83	78	150	147	91	174	485	125	106	149
1999	136	79	98	156	166	101	171	519	122	120	154
2000	130	77	89	161	156	97	171	544	121	108	152
2001	123	101	148	184	158	111	178	629	142	140	177
2002	144	97	133	177	150	121	166	489	132	121	163
2003	204	105	132	173	145	141	168	495	138	146	176
2004	159	102	155	165	123	148	151	423	130	131	167
2005	175	114	129	145	138	144	171	418	127	136	172
2006	191	110	117	153	144	149	193	442	138	132	182
Year	**Food**	**Textiles**	**Shoes/Leather**	**Wood**	**Chemicals**	**Transport**	**Machinery**	**Electrical E.**	**Other M.**	**Services***	**Total**
2007[a]	574	131	187	281	551	620	599	182	141	n.a.	404
2008	1,105	269	356	616	1,143	1,390	1,520	405	271	n.a.	896
2009	1,201	276	380	666	1,818	1,156	1,198	394	301	n.a.	885
2010	1,188	286	352	647	1,002	1,298	1,314	415	308	n.a.	865
2011	1,093	299	286	642	1,048	1,341	1,359	420	281	n.a.	903
2012	1,073	270	255	651	756	1,346	1,250	370	263	n.a.	856
2013	1,152	258	264	684	1,347	1,300	1,359	381	249	n.a.	941
2014	1,135	265	306	684	799	1,256	1,264	379	253	n.a.	860

Source and notes as described in table A61.1.

Table A6.1.11. Labor Productivity: Domestic Economy of Mexico. Millions of Mexican Pesos (Constant Prices of 2008).

Year	Food	Textiles	Shoes/ Leather	Wood	Chemicals	Transport	Machinery	Electrical E.	Other M.	Services	Total
1990	609	136	151	597	482	249	593	132	1,071	2,149	564
1991	714	142	158	594	527	398	598	132	1,142	2,283	627
1992	637	140	159	572	512	365	529	127	1,040	2,239	596
1993	528	123	149	547	455	263	459	115	975	2,129	540
1994	528	119	150	555	460	277	472	121	972	2,148	555
1995	691	143	204	757	743	446	740	156	1,078	2,548	740
1996	868	171	250	839	883	594	946	207	1,230	2,804	858
1997	753	136	206	733	629	332	745	167	861	2,247	655
1998	651	114	192	667	574	321	663	140	833	2,192	597
1999	687	96	183	632	589	329	636	113	719	2,173	585
2000	705	87	163	561	590	309	588	103	677	1,955	543
2001	650	77	154	538	553	280	504	92	693	1,878	527
2002	640	82	169	549	557	308	505	100	643	1,757	540
2003	634	75	173	532	583	323	518	97	644	1,803	563
2004	665	84	182	532	585	361	658	104	564	1,734	583
2005	768	114	238	436	861	386	743	224	692	1,726	666
2006	775	132	247	453	1,251	431	782	252	705	1,686	726
Year	Food	Textiles	Shoes/ Leather	Wood	Chemicals	Transport	Machinery	Electrical E.	Other M.	Services*	Total
2007[a]	790	152	243	512	1,128	280	936	155	863	n.a.	513
2008	788	124	228	544	1,167	213	841	30	745	n.a.	478
2009	788	128	222	557	1,907	169	669	35	778	n.a.	537
2010	806	146	230	568	1,223	237	774	34	764	n.a.	488
2011	814	164	225	592	1,177	263	792	51	737	n.a.	501
2012	822	177	213	637	1,022	278	815	69	729	n.a.	495
2013	823	174	201	637	1,504	258	779	56	620	n.a.	510
2014	821	174	195	689	994	277	801	67	607	n.a.	471

Source and notes as described in table A61.1.

Table. A6.1.12. Labor Productivity: Total Economy of Mexico. Millions of Mexican Pesos (Constant Prices of 2008).

Year	Food	Textiles	Shoes/Leather	Wood	Chemicals	Transport	Machinery	Electrical E.	Other M.	Services	Total
1990	604	131	147	536	475	212	528	173	735	1,992	519
1991	706	136	153	523	519	313	532	176	767	2,097	571
1992	629	133	154	503	502	304	466	167	723	2,057	541
1993	521	116	145	462	444	219	402	150	645	1,964	486
1994	524	111	144	473	450	225	402	156	638	1,996	495
1995	683	132	195	622	721	333	617	209	691	2,340	647
1996	856	154	239	690	856	445	783	271	757	2,570	744
1997	741	126	196	605	608	250	615	216	526	2,043	562
1998	642	106	181	544	553	245	555	196	511	1,974	512
1999	678	92	175	504	566	253	524	180	444	1,955	498
2000	696	84	156	453	565	236	484	171	421	1,750	462
2001	643	83	154	449	533	225	428	169	443	1,734	461
2002	633	86	167	446	535	241	415	170	411	1,626	464
2003	629	83	170	433	559	258	421	171	415	1,680	485
2004	657	89	180	430	552	284	501	172	366	1,590	492
2005	759	114	231	349	802	297	560	267	433	1,580	557
2006	766	127	237	362	1,142	327	597	294	444	1,537	606
Year	Food	Textiles	Shoes/Leather	Wood	Chemicals	Transport	Machinery	Electrical E.	Other M.	Services*	Total
2007[a]	752	146	231	463	911	423	786	167	535	n.a.	474
2008	844	167	253	559	1,158	702	1,139	183	532	n.a.	624
2009	858	174	256	582	1,873	597	902	178	564	n.a.	660
2010	871	189	259	588	1,132	703	1,019	187	559	n.a.	625
2011	864	205	242	604	1,123	737	1,046	198	531	n.a.	649
2012	867	206	225	641	906	749	1,013	189	519	n.a.	630
2013	883	201	219	650	1,432	718	1,054	185	452	n.a.	675
2014	879	202	226	688	903	710	1,022	192	446	n.a.	621

Source and notes as described in table A61.1.

Appendix A6.2

Table. A6.2.1 Contribution to Changes in Aggregate Labor productivity (%)

Food

Years	A (gross output / labor export sector)	B (upgrading export sector)	C (employment share export sector)	D (domestic sector)	Δ(Y/L)=A+B+C+D
1990-1994	-0.1	-0.1	0.0	-15.2	-15.3
1994-1998	0.0	0.0	-0.5	18.9	18.4
1998-2001	0.0	0.0	0.3	-0.2	0.1
2001-2006	0.3	-0.1	-0.1	16.1	16.1
1994-2001	0.0	0.0	-0.2	18.7	18.5
1990-2006	0.3	-0.3	-0.3	21.4	21.1
2008-2014	-0.4	1.1	0.2	3.3	4.2

Shoes/Leather

Years	A (gross output / labor export sector)	B (upgrading export sector)	C (employment share export sector)	D (domestic sector)	Δ(Y/L)=A+B+C+D
1990-1994	0.8	-1.4	-0.5	-0.4	-1.5
1994-1998	0.8	-0.6	-1.3	21.3	20.2
1998-2001	3.5	0.8	0.1	-22.0	-17.7
2001-2006	-1.1	0.1	-0.1	36.2	35.2
1994-2001	4.2	-0.6	0.0	2.6	6.1
1990-2006	2.4	-1.6	-0.6	38.1	38.2
2008-2014	-0.9	-3.0	3.8	-10.5	-10.6

Wood

Years	A (gross output / labor export sector)	B (upgrading export sector)	C (employment share export sector)	D (domestic sector)	Δ(Y/L)=A+B+C+D
1990-1994	1.1	-1.5	-5.2	-7.8	-13.4
1994-1998	0.1	1.5	-5.2	16.9	13.1
1998-2001	1.6	0.2	-1.1	-22.0	-21.2
2001-2006	2.5	-4.7	-4.2	-17.6	-23.9
1994-2001	1.0	2.3	-5.4	-3.1	-5.3
1990-2006	4.1	-2.9	-14.4	-34.8	-47.9
2008-2014	4.7	-2.1	-0.1	20.4	23.0

Chemicals

Years	A (gross output / labor export sector)	B (upgrading export sector)	C (employment share export sector)	D (domestic sector)	Δ(Y/L)=A+B+C+D
1990-1994	0.1	-0.1	-1.1	-4.6	-5.7
1994-1998	0.1	0.2	-1.4	19.9	18.7
1998-2001	0.3	-0.2	-0.1	-3.7	-3.7
2001-2006	-0.1	0.0	-4.7	58.0	53.3
1994-2001	0.2	0.1	-1.5	16.9	15.7
1990-2006	0.1	0.0	-8.0	66.3	58.4
2008-2014	-6.5	-4.4	-1.7	-9.5	-22.1

Sources and notes as described in table 6.3

Table. A6.2.3. Contribution to Changes in Aggregate Labor productivity (%)

Machinery

Years	A (gross output / labor export sector)	B (upgrading export sector)	C (employment share export sector)	D (domestic sector)	Δ(Y/L)=A+B+C+D
1990-1994	0.3	-1.8	-4.2	-25.7	-31.5
1994-1998	3.1	-1.2	-1.9	27.7	27.6
1998-2001	-1.5	1.7	-1.0	-28.9	-29.8
2001-2006	4.5	-3.9	-7.8	35.5	28.3
1994-2001	2.4	0.2	-2.7	6.1	6.0
1990-2006	5.9	-5.2	-16.1	26.8	11.5
2008-2014	-4.3	-5.5	1.6	-2.0	-10.2

Other Manufacturing

Years	A (gross output / labor export sector)	B (upgrading export sector)	C (employment share export sector)	D (domestic sector)	Δ(Y/L)=A+B+C+D
1990-1994	-0.1	-1.6	-3.6	-10.0	-15.2
1994-1998	2.0	-0.3	-9.9	-16.7	-24.9
1998-2001	2.1	-0.3	0.1	-17.3	-15.4
2001-2006	1.9	-2.3	-0.8	1.5	0.3
1994-2001	4.1	-0.6	-8.7	-38.9	-44.1
1990-2006	6.7	-6.2	-13.1	-53.0	-65.6
2008-2014	2.5	-4.0	-0.5	-14.2	-16.2

Services

Years	A (gross output / labor export sector)	B (upgrading export sector)	C (employment share export sector)	D (domestic sector)	Δ(Y/L)=A+B+C+D
1990-1994	0.1	-0.1	0.2	0.0	0.2
1994-1998	0.4	-0.4	-3.2	2.1	-1.1
1998-2001	0.2	0.0	2.2	-16.2	-13.9
2001-2006	-0.1	0.0	-1.3	-11.5	-12.8
1994-2001	0.8	-0.6	-0.9	-14.4	-15.1
1990-2006	1.0	-0.9	-1.9	-27.9	-29.6
2008-2014	n.a.	n.a.	n.a.	n.a.	n.a.

Sources and notes as described in table 6.3

Appendix A6.3

Table A6.3.1 Operationalization of Independent Variables.

Variables	Variable name (only those include in the regressions)	Operationalization.
TFP (index numbers): Solow Residual		$\ln\_TFP_i = va_i - (1 - s_{l,i})k_i - s_{l,i}l_i$ Following Gal (2013), Total Factor productivity at the firm-level ($\ln\_TFP_i$)is here measured with index numbers. Index equals one for the initial year of observation for each firm. va_i, l_i and k_i denotes gross value added, labor and capital stock for firm *i*, respectively.
Firm-level Investment		Domestic purchases of machinery and equipment and, the rental of buildings.
Initial capital stock		In line with Timmer (1999), initial capital stocks are here measured by applying the average of incremental capital value added ratios (ICVARs) in the first five years of the series to total value added in the initial year.
Capital stock		Capital stock (K_{t1}) measured following the Perpetual Inventory Method (PIM): $K_{t1} = [(1 - \delta)K_{t0}] + I_{t1}$ Where K_{t0} = initial capital stock; δ = depreciation rate; I=firm-level investment. Depreciation rates as determined by OECD (2001).
Size	*size*	Total number of employees per year
Age	*age*	Number of years reported by the establishment
Economies of Scale	*ln_output*	The logarithm of output
Use of imported intermediate inputs	*imp_interm*	The ratio of imported intermediate to total intermediate consumption
Export intensity for IMMEX firms	*foreign_income*	The ratio of foreign income earned by IMMEX firms to gross output by IMMEX firms.
Capital deepening	*capital_labor*	The ratio of capital stock to labor.
Quality of labor	*Blue_white_hours*	Hours worked by Low qualified labor/ Hours worked by high qualified labor
Share of highly-skilled in total employment	*tech_empleo*	Total number of technicians / Total number of employees
Labor composition	*labor_comp*	Average remuneration/ Total number of employees

Appendix A6.4

Table A6.4.1 Maquiladora: Basic statistics for the Dependent and Independent Variables

	Mean	Std.	Variance	Skewness	Kurtosis	Smallest	Largest	Obs
ln_pmaq	4.6	0.7	0.6	-0.3	5.4	0.4	9.1	34725
size	415	810	656,830	6.7	81.3	3.0	19,878	34728
size_squared	829,274	6,402,498	4.1E+13	28	1,172	9	4.E+08	34,728
age	4.3	4.0	15.9	1.0	3.3	0.0	16.0	34728
age_squared	34.0	53.0	2811.2	2.2	7.6	0.0	256.0	34728
imp_interm	0.7	0.3	0.1	-1.3	3.4	0.0	1.0	34657
ln_output	10.9	1.9	3.7	0.0	2.8	3.3	17.5	34728
capital_labor	218,119	3,107,467	9.66E+12	139	22,989	-6,360	5.E+08	34,728
blue_white_hours	5.8	7.0	49.0	16.2	603.2	0.0	363.7	23267
tech_to_empleo	0.2	0.1	0.0	1.6	6.9	0.0	1.0	34728
labor_comp	52	69	4,701	21	854	0	3,870	34,728

Table A.6.4.2 IMMEX: Basic Statistics for the Dependent and Independent Variables

	Mean	Std.	Variance	Skewness	Kurtosis	Smallest	Largest	Obs
ln_pmaq	5.9	1.2	1.3	0.1	5.2	-4	11	34,793
size	410	801	642,206	7	73	2	16,035	34,948
size_squared	810,156	5,957,108	3.55E+13	22	653	4	2.57E+08	34,948
age	2.9	2.2	5.0	0.3	1.9	0	7	34,948
age_squared	13	15	232	1	3	0	49	34,948
imp_interm	0.2	0.3	0.1	1.4	3.9	0	1	34,657
export_int	0.6	0.4	0.1	-0.5	1.7	0	1	34,948
ln_output	11.23	2.06	4.23	-0.16	3.28	-0.20	18.94	34,948
capital_labor	3,576,278	3.E+07	9.3E+14	24.7	735.5	0	1.34E+09	34,948
blue_white_hours	8.9	13.3	176.9	7.8	119.1	0	368	34821
tech_to_empleo	0.19	0.15	0.02	1.51	5.72	0.00	0.97	34,948
labor_comp	104	106	11,153	8	222	0	4,217	34,948

Sources and notes as described in table (6.3).

Appendix A6.5

Maquiladora: Correlation table between dependent and independent variables

	ln pmaq	size	size squared	age	age squared	imp interm	ln output	capital labor	blue white hours	tech labor	Labor comp
ln pmaq	1										
Size	0.0211	1									
size squared	0.0067	0.792	1								
Age	0.207	0.2337	0.0916	1							
age squared	0.1661	0.2218	0.0877	0.9494	1						
imp interm	0.0209	0.1663	0.0672	0.1512	0.1338	1					
ln output	0.4009	0.5786	0.2382	0.3532	0.3143	0.4302	1				
capital labor	0.2025	0.0268	0.0163	-0.0312	-0.0245	0.0069	0.1088	1			
blue white hours	-0.2065	-0.0116	-0.0062	-0.0706	-0.0747	-0.0048	-0.0714	-0.0455	1		
tech labor	0.3733	-0.0501	-0.01	0.0004	0.0192	-0.0962	0.0195	0.1051	-0.4924	1	
labor comp	0.5316	0.0278	0.0133	0.2054	0.2049	0.0439	0.2433	0.1705	-0.1294	0.3013	1

IMMEX: Correlation table between dependent and independent variables

	ln_pmaq	size	size squared	age	age squared	imp interm	export int	ln output	capital labor	blue white hours	tech empleo	labor comp
ln pmaq	1											
Size	0.0308	1										
size squared	0.0071	0.8158	1									
Age	0.0757	0.1132	0.0487	1								
age squared	0.0553	0.1168	0.0513	0.9561	1							
imp interm	0.3354	0.0321	0.0116	-0.0331	-0.0289	1						
export int	-0.262	0.085	0.0388	0.0677	0.0645	-0.2202	1					
ln output	0.6602	0.4801	0.2103	0.1646	0.1549	0.3003	-0.2223	1				
capital labor	0.1912	0.0851	0.0675	-0.0001	-0.0015	0.0753	-0.0521	0.1788	1			
blue white hours	-0.1981	0.1668	0.0483	0.0423	0.043	-0.0727	0.2014	0.0538	-0.0103	1		
tech empleo	0.3581	-0.0923	-0.0137	-0.0356	-0.0352	0.0991	-0.3407	0.1171	0.0637	-0.4523	1	
labor comp	0.2313	0.0431	0.0395	0.1178	0.1052	0.0372	0.0613	0.1272	0.0185	-0.0543	0.1984	1

Chapter 7.

Concluding remarks.

This final chapter summarizes our general conclusions and raises some points for further discussion. Section 7.1 briefly summarizes the main methodological and policy contributions from this dissertation in the analysis of countries participating in international production networks, as well as the main contributions we provide in the study of Mexican manufacturing. Section 7.2 presents our key empirical findings. In general, here we indicate that as a result of successful production for exports Mexico has become one of the largest manufacturing producers in the global economy. It has successfully increased industrial employment, as well as the share of the export sector in total manufacturing and has even redefined its position in global value chains. Nonetheless, we also highlight that despite these measures of success, the country has achieved insufficient upgrading. Given the importance from this latter finding, section 7.3 further discusses the different factors that account for the lack of upgrading in Mexico's exporting sector. Section 7.4, on the other hand, indicates some policy recommendations for other developing countries wishing to follow Mexico's successful attempt to increase output and employment at its exporting sector. Finally, section 7.5 indicates some key arguments derived from this dissertation to be considering during the 2017-2018 renegotiation of NAFTA regarding the role of Mexico's exporting sector in creating trade deficit with the US as well as the possible avenues to further strength the competitiveness from the North American region.

7.1 Methodological and Policy Contributions.

This dissertation has some important empirical and policy contributions for the study of developing countries seeking to participate in international production networks. Let us first refer to the empirical ones. Chapter 3 provided a framework that highlights that manufacturing is still a regional phenomenon for most countries and regions of the World economy, despite drastic decreases in communication and transportation costs. Chapter 4, on the other hand, offers one of the first long run studies on the domestic content of exports for countries highly engaged in Exports Processing Zones (EPZs). Such objective was achieved by constructing a unique dataset that projects (over 25 years) an official input output table to study EPZs with detail yearly information on inputs and outputs. Chapter 5 goes one step forward and includes some of those input output tables (IOTs) from chapter 4 in a larger multiregional IOT framework. By relying on official bilateral trade statistics for EPZ and for domestic manufacturing, Chapter 5 is also one of the first attempts to slice up an economy included in a World IOT dataset into its export processing and domestic manufacturing component, for more than 10 years. Slicing up a developing economy into those two components permits studying the value added contribution from the export sector and domestic manufacturing in the final output produced by a given country. Following the same reasoning, chapter 6 provides an new decomposition technique to account for the contribution of the export sector and of domestic manufacturing in changes in aggregate labor productivity levels for the total economy. In this new decomposition, we observe that 3 factors within the export sector (changes in output per worker, changes in value added to output ratio, and changes in labor shares with respect to total labor) and one factor within domestic manufacturing (changes in value added per worker) play a role in inducing changes in total labor productivity at the aggregate level. Finally, regarding the policy contribution from this dissertation, chapter 2 indicates that successful production for exports implies supporting firms participating in EPZs as well as domestic manufacturers producing for exports by means of different (and realistic) export performance requirements for each type of firm. This strategy will permit the industrial development of domestic manufacturers so as to eventually create one single export promoting framework where those latter firms can receive the same incentives as firms in EPZs (for details, please refer to section 7.5).

In addition, this dissertation also offers some interesting contributions with regard to the specific analysis of Mexican manufacturing. First of all, we provide here a thorough assessment of Mexico's export promoting policies over the last 50 years (Chapter 2). Not only does this review offers a detail analysis about the differences and complementarities between Mexico's two major export promoting programs (Maquiladora and PITEX), but also, we provide arguments to better understand the well thought policy reasoning that lead to the creation of the IMMEX program.

Providing long-run perspectives on the domestic content in final output and of labor productivity at Mexico's export sector are important contributions. Nonetheless, further providing a single framework to analyze the ways in which the export and domestic sector contribute to the value added structure of final output and, to changes in labor productivity for total manufacturing make this thesis unique. For instance, long-run perspectives on domestic and foreign value added content are provided in Chapter 4 (1981-2006), while long-run insights from labor productivity can also be inferred from Chapter 4 and in Chapter 6 (1990-2014). The joint contribution from the domestic and export sector in the value added structure of final manufacturing output can be observed in Chapter 5, while the contribution from those two in total labor productivity levels can be found in Chapter 6. Lastly, it is also worth mentioning that this dissertation provides two empirical comparative analysis with respect to the old and the new statistical tools to analyze production for exports in Mexico. Chapter 5 relies on aggregate information for Maquiladora and for the new statistical concept of Manufactura Global, while chapter 6 utilizes both firm-level and aggregate information for Maquiladora and the IMMEX program.

7.2 Key Empirical Findings.

In Chapter 3, we empirically observed that Mexico has succeeded in becoming one of the largest manufacturing producers in the global economy. According to our calculation using the EORA dataset, by 2011 Mexico's production for exports ranked in the top list of manufacturing exporters along with developed economies (Germany, USA, Japan and Italy) and other emerging countries (China). Chapter 6 further confirmed this idea by highlighting the growing importance of the export sector in total manufacturing production in Mexico over the last decades. Since the opening of the Mexican economy to foreign markets, the export sector increased from rather low shares in output to almost half of manufacturing production and half of gross value added in Mexico, with a growing share in industrial employment.

Chapter 2 provides some interesting insights regarding the policy reasoning behind successful production for exports in Mexico. In general, here we argue that it is not only the Maquiladora program that account for the growing importance of the exporting sector. A carefully designed program that slowly induced the production for exports from small and medium enterprises within domestic manufacturing producers (PITEX program) complemented with other policy instruments (such as drawback systems, DIMMEX and so forth) also played an important role in explaining successful export production. Unique and preferential access to one of the top export markets in the World economy, as well as the set of competitive advantages enjoyed by Mexican manufacturing (as described in Chapter 5) also account for this issue.

Other important finding, that also highlights to the growing importance of Mexican manufacturing, is the changing position of this country in global value chains since the beginning of the millennium (Chapter 5). While domestic producers continue participating in local and regional value chains (with US and Canada) in most manufacturing sectors, the export sector showed drastic changes in their value added structure. Depending on the manufacturing sector being analyzed at the export sector, Mexican manufacturing can participate in local value chains (Transport sector), regional value chains with North America (Textiles) or global value chains with East Asia (Electronics). Given the predominance of the electronic sector within total production for exports, we conclude that such exporting sector in Mexico mostly participates in global value chains. Nevertheless, this latter conclusion (the export sector mostly organized in the context of global value chains) is only reflecting the fact that US firms (previously sourcing input to the export sector in Mexico) relocate their intermediate production to China and Asia, thus increasing the share of value added embodied in Mexican exports to the US.

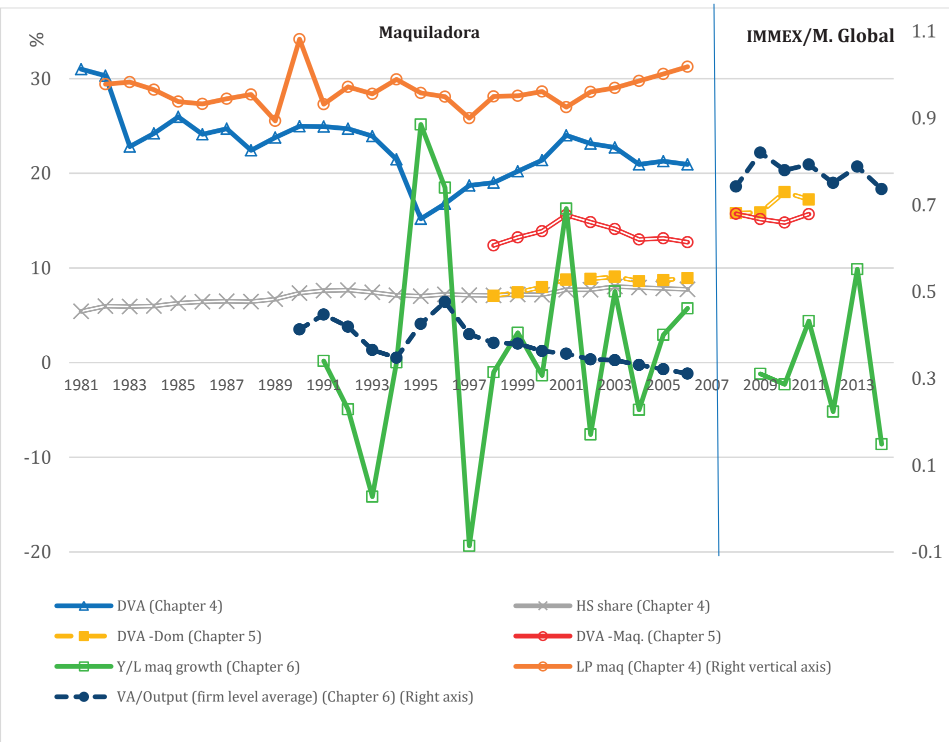
Finally, the most important finding from this dissertation is the existence of insufficient upgrading in the production for exports. This finding is corroborated when assessing the four dimensions of upgrading studied by this dissertation as proposed during the introductory chapter; (1) domestic content of exports (Chapter 4 and 5); (2) value added to output ratios (Chapter 6) ; (4) labor productivity (Chapter 4 and 6), and; (2) participation of skilled labor (Chapter 5). To better understand my view on the modest upgrading in the production for exports, figure (7.1) presents our key empirical results regarding the four dimensions of upgrading that were studied in chapters 4 to 6 in this dissertation. The main objective behind presenting different results that followed different methodologies and datasets is to understand their trends over the years.

Following previous figures and tables in this dissertation, figure (7.1) is divided in two main panels with the first one presenting results for different dimensions of upgrading for Maquiladora from 1981 to 2006 and, with the second indicating the respective results for new statistical tools to analyze production for exports from 2008-2014 (Manufactura Global and IMMEX, respectively). In the next paragraphs, we will explain how those dimensions of upgrading are related to each other, which are their main differences and, more importantly, how all those measures lead us to conclude insufficient upgrading in production for exports.

Let us start with the first dimension, i.e. the domestic content of exports. Here, DVA (Chapter 4) in figure (7.1) indicates the domestic value added content of Maquiladora final output from 1981 to 2006. DVA-Maq (Chapter 5) extended this analysis from 1998 to 2011 by relying on a different methodology and a larger multiregional dataset than Chapter 4. By connecting both findings in those chapters, we can conclude that the domestic content of exports has experienced a long-run decline from 1981 to 2014. Chapter 5 is only capturing one specific period of such long-run decline where modest increases in DVA are observed with respect to the pre-NAFTA levels. The latter means that the domestic value added structure in total exports induced by NAFTA in 1994 has basically remain unaltered by 2011. One important additional insight is obtained by comparing our DVA results in Chapter 4 and 5. The total DVA calculated in Chapter 4 is higher than the DVA computed in Chapter 5. This is because calculating the total domestic value added contribution in exports in Chapter 4 implies adding the concepts of DVA-Maq and DVA-Dom observed in figure (7.1). Having two different domestic value added contributions for a single country is the result of slicing up Mexico in Maquiladora and domestic components in a multiregional dataset. Such DVA-Dom (Chapter 5) in figure (7.1) remains unaltered further confirming my view on lack of changes in upgrading since 1994.

Regarding the second dimension of upgrading, figure (7.1) presents the average firm-level value added to output ratio obtained in Chapter 6. Given that this ratio is reflecting shares from 0 to 1, the reader should note that this variable is measured on the right axis of figure (7.1). In general, we observe that the average firm-level value added to output ratios also remains unaltered by evolving around 0.4 for Maquiladora (1990-2006) and 0.7 for IMMEX (2008-2014). In addition, we notice that, for some years, this ratio does not necessarily follow the same trend as the DVA calculations in Chapter 4 and 5. For instance, while we observe an increase in the average value added to output ratios by 1995, that same year implied a decrease in the DVA content in Chapter 4. Likewise, the years from 1997 to 2001 implies slight increases in DVA (Chapter 4), while the average value added to output ratio presents decreases. These slight differences between the trend in the firm-level value added to output ratio and the trend of DVA are related to the fact that the first variable is only taking into account the contribution of direct domestic suppliers, while the computation of the second variable (i.e., DVA) implied considering the contribution of direct suppliers and indirect exports. In my view, if we had incorporated firm-level information on the value added contribution from indirect exporters to our firm-level measure of value added to output, we would have surely seen an approximate trend to the one described by DVA in Chapter 4.

Figure (7. 1): Different Dimensions of Upgrading in Mexico's Export Sector: 1981-2014.



Source: Author's calculation based on aggregate data for EMIME (1981-2006), IMMEX (2008-2014), Manufactura Global (2008-2014), as well as firm-level information for EMIME (1990-2006) and IMMEX (2008-2014).

Notes: DVA (Chapter 4), DVA-Maq (Chapter 5) and, DVA-Dom (Chapter 5) refer to the percentage share of domestic value added embodied in final output for maquiladora production and for domestic manufacturing, respectively. HS-Share (Chapter 4) refers to the percentage share of highly-skilled workers in total workers. Y/L maq growth (Chapter 6) refers to the annual labor productivity growth in Maquiladora and IMMEX, respectively. Since all these measures refer to percentages, they have to be read on the left axis of figure (7.1). On the other hand, VA/Output (firm level average) refers to the average ratio of value added to output for Maquiladora and IMMEX, while LP maq (Chapter 4) refers to the annual labor productivity in Maquiladora from 1981 to 2006 using the first year of observation as a base year (1981=1). Given that these two measures evolve around 1, they have to be read on the right vertical axis of figure (7.1).

In the case of our third dimension of upgrading, figure (7.1) presents two different measures of labor productivity. On the one hand, Chapter 4 measured labor productivity for Maquiladora by dividing real value added by hours worked from 1981 to 2006. With such information, an index was constructed which equals 1 in 1981. Given this situation, the reader should note that the variable LP maq (Chapter 4) has to be read on the right axis of figure (7.1) On the other hand, Chapter 6 measured labor productivity as gross value added per worker from 1990 to 2014. In this context, the variable Y/L maq (Chapter 6) in Figure (7.1) is indicating the annual aggregate productivity growth in the export sector. At first glance, by comparing those two productivity measures, one could argue that they are reflecting two different trends. Nonetheless, in my view both measures suggest that the export sector in Mexico has experienced (in general) modest positive increases in labor productivity over the last decades.

LP maq (Chapter 4) indicates modest positive growth with respect to the labor productivity levels observed in 1981. Y/L maq (Chapter 6) studies annual productivity growth and indicates far more pronounced changes than the ones observed in the previous measure of productivity. Nonetheless, from the variable Y/L maq (Chapter 6) we can also infer modest productivity increases given that most of the changes observed from 1991 to 2006 are negative or close to zero and thus, they even out with the positive ones. One important additional finding from Chapter 6 is that despite the modest increases in productivity, firm-level gross value added per workers shows heavy variation over the years, thus suggesting large differences in productivity levels between firms.

Chapter 6 also mentioned that productivity at the export sector increase rapidly from 1990 to 2014. This conclusion is still valid. Nonetheless, the reader should note that the last year of observation for this latter conclusion is 2014 and, thus in achieving this conclusion we are no longer considering only exporting firms (as we did in 1990) but a broader set of firms that produce both for domestic and foreign markets (IMMEX).

In the case of our last dimension of upgrading, we observe that the share of highly skilled workers in total employment for Maquiladora (1981-2006) remained with no changes. This is the variable HS share (Chapter 4) in figure (7.1). According to Chapter 6, increasing such share is remarkably important as positive increases in the share of highly-skilled workers were found to have a statistically significant and positive impact on firm-level productivity. Alternatively, to further confirm the positive impact of highly-skilled workers, Chapter 6 also indicated that increasing the working hours of low-skilled workers with respect to those of the highly-skilled will have a negative and statistically significant impact on firm-level productivity.

With these ideas in mind, we now proceed to next section where we aim to explain the reasons for the lack of upgrading in Mexico's export sector.

7.3 Factors (and their Implications) that Account for the Lack of Upgrading in Mexico's Exporting Sector.

A general finding from this dissertation is that the domestic value added content embodied in Mexico' final manufacturing output has been progressively declining in the last decades. The extent of this decline differs greatly depending on the type of production being analyzed (total output produced in Mexico, domestic manufacturing and production for exports) and even considering different manufacturing sectors. Each chapter in this dissertation attempts to provide answers as to why the domestic content of Mexico's final output has been decreasing over the years.

Chapter 3 decomposed the value added content embodied in the final output produced by top exporters (including Mexico) and regions of the world economy for 1990 and 2011. In this chapter, we observe that for any given country the final output of which is decomposed into different value added contributions by country of origin, domestic value added represents the lion's share in final output. Over time, foreign value added content tends to increase, indicating that domestic producers are increasingly participating in international production networks. Nevertheless, the top exporters in key manufacturing sectors (textiles and electronics) in advanced and emerging economies tend to present greater increases in the foreign value added embodied in their final output than the rest of countries (developing world). The reason for this is that, in recent decades, top exporters have faced stiff competition in terms of price and quality and have been pushed to increase their ties with efficient foreign producers that are located not only within their region but also outside of it. In contrast, domestic producers in most of the developing world have faced less competitive pressures and, thus, they present lower foreign value added content in their output than the top exporters. In this context, this chapter indicates that one reason for the decreasing domestic value added content embodied Mexico's total final output is that this country is a major top manufacturing exporter that has increased its interaction with other foreign producers that are mostly located in North America. Nevertheless, despite these decreases in domestic value added content, most manufacturing production is Mexico is still organized locally.

While chapter 3 takes a global perspective, Chapter 4 zooms in on the Mexican Maquiladora sector. It examines the domestic and foreign value added content embodied in Maquiladora final output for 25 years (1981-2006). Here, we observe that the production for exports shows different patterns than total manufacturing output (as discussed in Chapter 3). In Maquiladora, foreign value added has the lion's share final output, while domestic content is relatively small (in contrast to the high domestic content in total Mexican manufacturing. More importantly, the domestic content of Maquiladora output shows a long-run decline from 1981 to 2006, far more pronounced than the decline for the case of total final output in chapter 3. Two key factors account for the long-run decline in the domestic content of Maquiladora output. First, the aggregate decline is driven in particular by the falling domestic content within the electrical equipment sector. Second, policy shifts and major currency devaluations (in 1981 and 1994) drastically altered the foreign sourcing structure of maquiladora firms and limited their demand for local inputs in the years thereafter. Therefore, we conclude that the domestic content of exports in Maquiladora depends on the upgrading or downgrading trends in the sector that has the highest shares in output (electronics) and on a set of external shocks that the economy is subject to: increasing outward orientation and economic crisis.

Chapter 5 provides a further analysis of why the decline in the domestic content of exports in Maquiladora has been more pronounced than the decline in the domestic content of total manufacturing output. In this chapter, it is argued that what happens in total manufacturing closely reflects the sourcing structure from domestic manufacturing. Let us elaborate on this. To produce final output (both for domestic and foreign consumption), domestic producers primarily source their intermediate inputs from other domestic suppliers in Mexico. As a result of the increasing globalization of production that took place at the beginning of the 2000's, domestic producers in Mexico did increase their ties with their North American counterparts but they did not drastically modify their high demand for local inputs. Therefore, the domestic value added embodied in the final output from domestic manufacturing did not substantially decreased. Conversely, for the case of Maquiladora output, the increasing fragmentation of production implied an interesting change in its foreign value added structure. Foreign value added in Maquiladora output switched from the dominance of the US foreign value added content in every single manufacturing sector to a much more diversified value added structure. In the electronic sector, the East Asian share in the value added content of final output is increasingly high. In the transport equipment sector, value added from domestic producers accounts for the lion's share, while US value added share is the highest in the textile sector. We conclude that the domestic content of maquiladora output has had a more pronounced decline than that of total manufacturing because such production has become increasingly integrated in global and regional value chains. Domestic manufacturing production is still mostly organized locally despite increasing ties with North American producers. Given the weight of domestic manufacturing in total manufacturing, this affects the domestic value share in total manufacturing output.

Chapter 6 shows that one of the main implications of the decreasing domestic value added content in Maquiladora exports is related with the limited contribution of the export sector to aggregate labor productivity in total manufacturing. Upgrading in the export sector (defined as increases in the value added to output ratio) both for the case of Maquiladora and IMMEX was never strong in 24 years of analysis (1990-2014). In this chapter, we observe that the contribution of upgrading to changes in aggregate labor productivity was small and negative.

Labor productivity in the export sector has a different impact than the upgrading variable. In this case, the contributions from productivity at the export sector to changes in aggregate labor productivity were positive but still small. The small effect has to do with the fact that labor productivity in domestic manufacturing makes by far the largest contribution to aggregate productivity. Firm-level labor productivity in the export sector shows great variation over time than the upgrading variable during the same years. In my view, there are two main channels by which low levels of upgrading prevent the realisation of higher labor productivity in the export sector. First, the use of domestic inputs of low technological complexity would prevent the Maquiladora to compete with other foreign producers in terms of price of quality. Second, introducing new machinery and equipment in a Maquiladora might increase labor productivity but labour productivity increases depend on other complementary factors such as better training and higher qualification of labor that were not forthcoming.

According to our results in chapter 4 and chapter 6, higher labor productivity at the expense of lower upgrading was specially seen in 1994. Such situation can be observed in figure (7.1) by comparing the labor productivity results in 1994 for the variable Y/L maq growth (Chapter 6) and the domestic value added results in 1994 for the variable DVA (Chapter 4). Chapter 4 states that in 1994, as a result of NAFTA and the currency crisis, the domestic content of exports experienced a drastic decline from 21% to 15% in 1995. On the other hand, chapter 6 indicates that in the 1994 labor productivity levels and labor productivity growth in the export sector experienced a substantial increase (from 0% to 25% in 1995, for the case of the latter). Therefore, in the immediate years that followed the signing of NAFTA, higher aggregate productivity at the export sector was realized at the expense of lower domestic value added content in final output. After 2001, we observe that productivity growth is mostly positive while the domestic content of exports is mostly declining.

Despite modest increases in labor productivity and low upgrading, the export sector should not be regarded as a stagnant one. Between 1990 and 2014, the export sector increased from rather low shares in output to almost half of manufacturing production and half of manufacturing gross value added in Mexico, with important and increasing shares in manufacturing employment. In this context, it can be concluded that the export sector has rapidly increased its contribution to output and employment, but it could have made a much larger contribution if it had experienced more upgrading (higher domestic value added content and higher value added output ratios) and more rapid growth of labour productivity.

Considering all these arguments, we can now identify the factors that induce decreasing domestic content for final output in Mexican manufacturing and, that can also be observed for the case of any other developing countries highly engaged in international production networks. When we only study total final output produced by the country, the domestic value added content will only present small decreases. Given the aggregate nature of total final manufacturing output (i.e. jointly considering in a single category the production for foreign and domestic markets), this small decline can be attributed to higher interaction with foreign suppliers. Declines in the domestic content of output will be higher than average for top manufacturing exporters such as Mexico, because manufacturing producers in such countries had an incentive to drastically increased their interaction with foreign producers located within and outside their own region.

On the other hand, when we consider the final output in the exporting sectors only, foreign value added content will be much higher than the domestic one. In light of the increasing (and ongoing) fragmentation of production, the domestic content of exports must show on average a tendency to decline. In a long-run perspective, attention must be paid to the changing sourcing structure in the sectors with the largest shares in output and to the external shocks observed at the exporting sector (increasing outward orientation and crises). When comparing domestic content in exports and domestic content in total final output, we will observe that the former experiences much more pronounced declines than the latter. The reason for this is the fact the production for exports might be organized in the context of regional and global production networks depending on the modularity from each manufacturing sector and the competitive advantages offered by the exporting sector to foreign producers wishing to reallocate production to such country. Declines in the domestic content from total manufacturing, on the other hand, will not be as pronounced as the ones at the exporting sector because total manufacturing reflects a sourcing structure in which domestic producers mostly rely on local suppliers.

Upgrading (or the lack thereof) in the exporting sector will play a major role in determining its contribution to aggregate labor productivity. Given the large size of domestic manufacturing (when compared to the export sector) in terms of gross output, gross value added and employment, the domestic component of total manufacturing will drive aggregate changes in labor productivity growth for total manufacturing. Limited and even decreasing upgrading in the export sector can result in net negative contributions to aggregate labor productivity. Even if the export sector shows labor productivity growth, lack of upgrading will result in a much smaller contribution to aggregate changes in the productivity growth and levels for total manufacturing than would be the case if value added output ratios were much higher.

7.4 Policy Lessons from Mexico's Export Promoting Experiences.

As mentioned in previous paragraphs, one of the key findings of this dissertation is the decreasing domestic content in exports. Nevertheless, another key finding is that the exporting sector in Mexico has continuously increased its shares in total manufacturing output, total gross value added and employment. The factors that usually mentioned in accounting for the success of the exporting sector are the Maquiladora framework, the signing of NAFTA in 1994 and the competitive advantages offered by Mexico. This dissertation makes the case that Mexico's export promoting policies for domestic manufacturing firms also play a major role in explaining successful production for foreign markets. Mexico's increasing production for exports should not exclusively be associated with the implementation of export processing zones (the Maquiladora framework) or the signing of free trade agreements (NAFTA) but also with specific policies to induce increasing exports from firms in the domestic sector (the PITEX program, in this case). As discussed in chapter 2, the PITEX program (with the help of other complementary programs such as DIMMEX) was designed to gradually stimulate the production for exports by domestic firms with no prior experience in international markets. By coexisting with the Maquiladora program, the PITEX program proved to be successful as it allowed the integration in global markets and the industrial development of different kind of domestic manufacturing firms (including SMEs). A merging between the two export promoting schemes into a single scheme (IMMEX) was necessary to further ensure the continuous development of exporting capabilities within the domestic sector.

In my view, implementing two parallel export promoting programs (similar to Maquiladora and PITEX) and eventually merging them into a single framework (such as IMMEX) constitutes a valid policy alternative which could be replicated by developing countries seeking to increase their production for exports and to employ more labor in manufacturing industries outside the informal sector. Therefore, in line with the Mexican experience with Maquiladora and PITEX and the eventual emergence of the IMMEX program, this dissertation will propose here a number of specific policies to be followed in order for other developing to obtain the previously mentioned objectives of higher exports and employment.

First of all, the general export promoting framework at any given developing country should explicitly support the development of two specific type of firms; (1) manufacturing firms that seek to produce excusively for foreign markets (i.e. those foreign firms that participate in export processing zones) and, (2) manufacturing firms that seek to produce for both the domestic and foreign markets (and which can be of foreign or domestic origin). An increasing interaction between the first and the second group of firms is a key factor to ensure the development of exporting capabilities for domestic manufacturing firms.

For the first group of firms, policy makers should implement incentives for foreign firms to reallocate production to the country. Tariff exemptions and tax incentives should be provided for the imports of several intermediate goods as well as imports of machinery and equipment. Further incentives should be granted for the domestic purchases of intermediate goods locally produced.

For the second group of firms, the government at the developing economy should promote the aim that their domestic firms become as competitive as the foreign firms that operate in the country's EPZ. In this regard, the Mexican experience highlights that the context in which domestic producers operate should be taken into account to successfully achieve the latter objective. For instance, if the developing country is currently at the early stages of industrialization, this would suggest that local manufacturing lacks the necessary skills to produce for exports as they might be only producing for the domestic market. This latter fact (domestic firms exclusively producing for the domestic market) would also suggest that those firms mostly rely on domestic intermediate inputs as they also might lack of the necessary means to interact with foreign producers of intermediate goods. Thus, the government should implement a program similar to that of the EPZs but aimed at the industrial development of all the firms in domestic manufacturing (major local firms, SMEs and local suppliers to those two firms). Nonetheless, unlike foreign firms in EPZ, granting tariff and tax incentives should be provided conditioned on export performance. Tariff and tax incentives on the import of raw materials can be provided to all firms in the domestic manufacturing of our developing country provided that those firms export at least 10% of their total production. A minimum of 10% is here imposed precisely to allow for the participation in this program of more and more SMEs that want to produce for foreign markets but that can only start doing this slowly. On the other hand, tariff incentives for the imports of machinery and equipment can be provided to those domestic firms in the developing country that export more than 30% of their final output. This second export performance requirement is set for those major firms that can already export a larger amount of their final output than firms of small size. It is also set as additional objective for the development of SMEs. If SMEs in our developing country start exporting progressively more (beyond 10%) not only should they be able to import raw materials free of duty but also machinery and equipment. The same set of rules should be established for the local suppliers of intermediate goods in our developing country. Additional tariff and tax incentives can be provided to major firm and SMEs provided that they continue (or increase) their purchases of inputs from local suppliers. The continuous development of all firms in the domestic sector from our developing country will mobilize more resources (capital, labor, etc.) in favor of manufacturing and against the informal sector.

The Mexican experience with Maquiladora and PITEX also teaches us that the difference in rules of operation governing the export processing zone and the program for the exports of domestic manufacturers should progressively decrease over time. Eventually, these rules of operation (export performance requirements to obtain tariff incentives) should eventually become identical for firms registered within the two programs. This final step (merging the two export promoting programs) should be implemented once domestic manufacturers have achieved sufficient capabilities that allow them to properly compete in international markets. Finally, one important thing to highlight is that these policy recommendations to achieve higher output and employment in the exporting sector are complementary to other key factors that determine successful production for exports such as the network of trade agreements signed by the developing country and the set of competitive advantages offered by the same economy. The current context of stiff competition triggered by the emergence of well-defined and efficient international production networks in East Asian countries should also be considered when deciding which industries are the key priorities for the successful production of exports in our given developing economy.

7.5 General Guidelines for the 2017-2018 Renegotiation of NAFTA: Some Insights from the Maquiladora Industry.

The renegotiation of NAFTA started in mid-August 2017 and it is expected to continue during 2018. One of the key concerns of the current US administration (that took office in January 2017) is to reduce the existing trade deficit with Mexico. In this regard, the exporting sector in Mexico (and more specifically the Maquiladora industry) is at the very center of such debate. In the view of the US administration, the source of the trade deficit is the fact that goods previously manufactured in the US are now being produced in Mexico, as a result of the continuous (and ongoing) reallocation of manufacturing facilities from the first country to the latter as induced by NAFTA. In the view of US policy makers, NAFTA should be modified in order to reduce the US trade deficit with Mexico and allow for a fairer exchange of goods between the two countries with less negative effects for the US economy.

The general findings of this dissertation can be used to debate the current negative perspective from the US administration attached to the signing of NAFTA. Let us first discuss what trade deficit implies for a country in the context of international production networks. According to chapter 2, given the interaction of many countries in the production of a given manufacturing good, we see a context where intermediate goods cross international borders several times before turning into a final good. Therefore, trade imbalances (such as the one between the US and Mexico) do not simply reflect the fact that one country is selling less and buying more output from another nation. In the context of international production networks what a trade imbalance reflects is the fact that this country (in this case the US) is obtaining a higher return for their investment in the production of intermediate inputs (which eventually return to the country in the form of a final good), than the returns that it could have obtained if those intermediates had been domestically assembled in the US. In a nutshell, domestically selling those imported goods manufactured in Mexico (with no import tariff imposed by the latter) implies higher value added and higher profits for US firms than what they could have achieved had assembly operations stayed in the US.

Indeed, more and more manufacturing firms are reallocating operations from the US to Mexico. However, with very few exceptions (the transport sector), they are still mostly reallocating the labor intensive part of manufacturing (assembling operations) to Mexico. Such argument is further confirmed by one of the key findings from this dissertation, i.e. the fact that the exporting sector in Mexico has not yet experienced a substantial process of industrial upgrading. In this perspective, since assembly is now outsourced and henceforth labor costs are now being reduced, US firms can increase their investment in the production of technologically complex intermediate goods. With no import tariffs imposed by neighboring Mexico neither on the exports of intermediates by the US nor on imports of final goods by the same country, US firms obtain a high return on their investment on intermediate goods after locally selling output assembled by Mexico. Even if assembled in Mexico, chapter 5 from this dissertation indicates that those final goods imported by the US from Maquiladora have a large US foreign value added content, in spite of increasing value added shares of East Asian countries in the same final output.

Let us now debate the idea of pursuing a "fairer" exchange of goods with less negative effects for the US. Imposing trade barriers to the current free exchange of manufacturing goods between the US and Mexico will have far worse consequences for both countries rather than simply reducing the US trade deficit in favor a "fairer" economic relationship. New tariffs on the imports of Maquiladora output by the US will definitely have negative effects on Mexico's exporting sector; output will be reduced and consequently so will manufacturing employment. Even if the US imposes tariffs on the deliveries of Maquiladora output from Mexico, it is quite likely that Mexico will still permit the free delivery of intermediate inputs coming from the US. This is one of the key policy guidelines governing the Maquiladora framework since the 1960s and still continues in the context of the IMMEX program given the objective of the Mexican government to incentivize the reallocation of manufacturing facilities to the country. However, tariff barriers for the deliveries of Maquiladora output to the US market will imply less profits for US firms, higher prices for US consumers and, consequently, an eventual reduction of US manufacturing employment.

In the logic of the current US administration, the underlying reason for limiting imports from Mexico is inducing more US firms to return to their country of origin to create more employment in regions that were heavily affected by the reallocation of manufacturing capabilities to Mexico. As can be seen from our previous arguments, limiting manufacturing imports from Mexico will have the precise opposite effect and can even lead more US firms to abandoning not only Mexico, but also the US, in favor of East Asia. On the one hand, to adjust their decreased profitability and to counteract the price increases in the local market resulting from higher import tariffs, it is likely that many US firms will decide to cut labor expenses, further decreasing the already declining levels of US manufacturing employment. On other hand, it is widely known that many foreign firms are located in Mexico in order to benefit from the Maquiladora framework (that allows the free imports of intermediate inputs from anywhere in the world), from the Mexico's cheap labor supply and, more importantly, from the free access to the US market provided within NAFTA framework. As seen in chapter 4 from this dissertation, for Maquiladora production, this is specially the case of firms within electronic manufacturing which, according to chapter 5, have integrated Mexico into global production networks with East Asia. This is because US electronics firms located in East Asia send intermediate inputs to Mexico which are later transformed into final goods that have duty free access to the US market, provided that some North American inputs are being used in such production.

If Mexico loses its duty-free access to the US market, firms within electronics manufacturing in East Asia will lose their main incentive to produce in Mexico. They will find the previously mentioned mandatory use of North American inputs, which is expected to remain unaltered, increasingly inconvenient. Given that most of their inputs are sourced from East Asia, and the evident lack of upgrading in Mexico's exporting sectors, those East Asian firms will have an incentive to reallocate back to their region of origin and produce directly for the US market from there. If paying import tariffs to gain access to the US market becomes inevitable, those firms would prefer to pay it by sending their goods directly from the Asia, given the high value to weight ratios governing its production.

Likewise, American firms that decide to abandon Mexico in order to avoid import tariffs might find reallocating to the US costly as labor costs are much higher in such country than in Mexico. Just like the case of East Asian firms, if paying import duties to access the US market becomes inevitable, then those American firms might also be willing to reallocate to cheaper locations in East Asia (not only in terms of labor but also considering the price of intermediate inputs) and to produce for the US market directly from such region. In this scenario, one may conclude that imposing trade barriers to Mexico (and to the Maquiladora industry in specific) could actually help the US reduce its trade deficit with this country. Nevertheless, the current US administration should be aware that imposing trade barriers with Mexico will also imply, at in least in the short run, higher levels of manufacturing unemployment, less profits for US firms, higher prices for final goods for US consumers, firms abandoning the North American region and, more importantly, an increasing trade deficit with East Asian countries (specially China).

Now, with regard to Mexico, there is one important final question. Can Mexico and its exporting sector survive in a world without NAFTA? In my view, Mexican manufacturing could survive such a negative shock, but this would come at the expense of further reducing the incipient process of industrial upgrading at the export sector. The imposing of higher US tariff and non-tariff barriers on Mexican imports, the disappearance of NAFTA or Mexico's withdrawal from the agreement would inevitably imply a large contraction of output in the export sector, an eventual decline in the levels of manufacturing employment and, lower levels of foreign direct investment in the economy. Assuming the end of the agreement, and in order to alleviate the previously listed negative effects for the economy, policy makers in Mexico would immediately modify the IMMEX framework to stop including some of the obligations imposed by NAFTA.

In line with chapter 2, to further strength productive linkages between the North American region, NAFTA required its signatory countries to impose tariffs on the imports of goods that had not been previously produced within the region, effective as of 2001. The latter meant that from 1994 to 2001, Maquiladora firms would enjoy unique privileges by importing free of duty to Mexico intermediate inputs produced anywhere in the world (within the Maquiladora framework) and by exporting, also free of duty, final manufacturing goods to the US (within the NAFTA framework). By 2001, the Maquiladora framework had to be modified in order to only allow for the free imports of those intermediate goods that have only been previously produced by the US or Canada (no longer from anywhere the world).

Nevertheless, chapter 2 also indicates that the Mexican government decided not to completely follow the latter requirement imposed by NAFTA. To prevent Maquiladora firms from leaving the country as a result of the new NAFTA regulation, policy makers in Mexico designed a list of those intermediate inputs that were more commonly imported by Maquiladora firms. Inputs falling within such list could still be imported by Maquiladora firms free of duty, regardless of what NAFTA required, and could still enjoy free access to the US market as long as the production of final goods used North American inputs. This is what we know as the Sectoral Promotion program (or PROSECs) which was defined by chapter 2 of this dissertation as a NAFTA framework designed by Mexico for non-NAFTA countries. In this context, if NAFTA ends, Mexican policy makers will eliminate the PROSECs regulations which are now included within the IMMEX framework. The objective here will be the exact same that lead to the creation of PROSECS, i.e. preventing Maquiladora firms from leaving the country. Further providing tariff and tax incentives within the IMMEX program in order for Mexico to continue participating in international production networks will be the main objective.

Permitting the imports of intermediate goods from anywhere in the world (again) with no restriction regarding a specific category of inputs listed by the government (PROSECs), the competitive advantages offered by the country to exports to the US (with some import tariffs imposed by the US) and the exports free of duty to other countries by which Mexico has signed a trade agreement with could become the new set of policies for the government in a post-end-of-NAFTA framework. The main problem now is whether those new policies would still be designed to induce higher output and employment in the sector export and could disregard and/or overlook, as in previous historic episodes, the situation faced by indirect exporter or local producers of intermediate inputs. In a nutshell, it is quite likely that in a scenario without NAFTA the government in Mexico would prefer implementing policies that reduce the already low domestic content of exports in favor of higher and/or stable levels of output and of employment. Given that the end of NAFTA can become a large negative shock for the Mexican economy, like the ones that took place in 1982 and 1994 as described in to chapter 4, we can expect a drastic decline in the domestic content of Maquiladora exports that will alter the sourcing structure of most Maquiladora firms and that will restrict their demand for domestic inputs to even lower levels in the years to come.

One important thing to mention is that the set of manufacturing capabilities that the exporting sector in Mexico has developed over the last 20 years as result of NAFTA constitute an important factor that could enable the country to survive, even without the existence of such agreement. The rather drastic scenario described in the very last paragraphs mostly refers to the case of electronics manufacturing which still accounts for the largest share in output at the export sector. On the other hand, as observed in chapter 6, the transportation sector is a key factor in the upgrading efforts. In my view, this sector would keep its rather harsh rules of origin (more than 60% of North American inputs) even in the absence of the trade agreement. This is because, as described in chapter 2, harsh requirements on the use of imports locally produced were present in the transportation sector even before NAFTA. In light of the specific characteristics of this sector (which demand close proximity to end markets), a large number of multinational firms within the PITEX framework established operations in Mexico by also setting up a network of suppliers in the country. This network of suppliers in Mexico has helped to increase the domestic content of exports in this industry. Given its development in the last twenty years, we regard it as unlikely that it would be reallocated to other countries, as would be the case for firms in electronics that only have assembly operations in Mexico and, nothing else.

So, which aspects of NAFTA need to be renegotiated? For the discussions regarding manufacturing goods, the North American region should aim to achieve further integration so as to properly compete with other regions in the world, such as East Asia and Europe. From the previous arguments elaborated here, I conclude that any attempt to limit the current free exchange of goods between Mexico and the US would have negative effects for the region, in favor of the regions that they are supposed to be competing with.

In my view, there are two ways to increase the North American competitiveness that would imply some changes in the current IMMEX framework. The first one is for Mexico to limit its support to other non-NAFTA countries in the context of the PROSECs program. It is clear that Mexico has prioritized its participation in international production networks outside the NAFTA region given the large amount of East Asian firms registered within its export promoting program. Nevertheless, this has come at the expense of the less upgrading in the export sector as well as lower competitiveness for the region. The scope for limiting the PROSEC program, however, will be limited and no immediate increases in upgrading or productivity can be expected if these changes are implemented. The second alternative is more realistic and has to do with the transport sector. Chapter 5 indicated that further bilateral cooperation between Mexico and the US in the transport sector could be associated with a higher domestic content in the exports of this sector. US and Canadian reallocating facilities to Mexico are behind those upgrading efforts and benefit by being able to operate under economies of scale, reducing costs and thus sending higher profits to their own economies. The resulting competitiveness of the North American transport sector that emerged as a result of this bilateral cooperation is out of question. The IMMEX framework should then be modified during the renegotiation of NAFTA to allow for further institutional cooperation in different areas of technology creation within most manufacturing sectors with a special emphasis on the transport sector.

This latter idea highlights what Maquiladora production really means for North America. From its inception, this industry has to be analyzed as a binational industry that has historically benefitted from preferential access both in Mexico's and US's customs regulations. Its expansion since the mid-1990s has benefited both economies. Henceforth, any renegotiation of NAFTA should aim at further expanding this binational industry, rather than destroying it.

Valorisation Addendum.

In line with article 23.5 of the Regulation Governing the Attainment of Doctoral Degrees at Maastricht University, this addendum discusses the valorization opportunities provided by this Ph.D. dissertation.

Developing economies are continuously seeking for industrial alternatives to catch up with the developed World. In light of the increasing fragmentation of manufacturing production, developing economies should also seek for strategies to integrate into these new ways to organize manufacturing production and capture as much benefits as possible. The key to successfully integrate in international production networks, however, goes beyond obtaining immediate benefits in terms of higher output for exports, foreign direct investment and employment. More importantly, a successful (and complete) integration in global manufacturing should also imply an important transformation of domestic manufacturing capabilities by means of higher labor productivity levels, higher use of skilled-workers and increasing domestic content in manufacturing exports.

This dissertation explored the industrial strategy followed by Mexico to integrate its manufacturing firms into international production networks. It also explored and quantified the different set of benefits that Mexico obtained after having pursued such strategy. This dissertation claims that developing economies should pay special attention to the Mexican case if their objective is to maximize the set of immediate benefits that global manufacturing offers to less developed economies (higher output, employment and foreign direct investment). Developing economies, on the other hand, should look somewhere else if they also aim to substantially transform their export sector towards more technologically complex activities. By means of any relevant indicator (labor productivity, domestic content of exports, etc.), Mexican manufacturing has mostly failed to advance towards more complex activities in the value chain.

Three aspects of the industrial strategy in Mexico studied on this dissertation deserve special attention. They can easily be replicated by developing economies that seek to become a manufacturing powerhouse. The first one is that the strategy for the industrial development of exporting firms should be a regional one. A regional strategy that is implemented not only at the country level, but that also considers regional complementarities with neighboring countries. On the one hand, at the country level, exporting firms should be located in a single region that benefits of close proximity to harbors and foreign markets. Beyond the potential benefits for exporting firms triggered by specialization and spill-over effects, this industrial strategy should also aim to increase the levels of income and of employment within that region. The Mexican case highlights that once a successful pattern of manufacturing specialization has been achieved within a given region, policy makers should aim to induce other type of exporting firms to locate elsewhere in the country (i.e. a second regional strategy). On the other hand, at the level of neighboring economies, the first regional strategy should also be designed by explicitly addressing potential complementarities with other countries located nearby. Complementarities not only in terms of infrastructure or factor endowments that are scarce one county but that are not in other. More importantly, complementarities in terms of benefits that are offered to investors and exporting firms and even some sort of institutional complementarities. One more time, the Mexican case highlights the fact that further bilateral cooperation between Mexico and neighboring US (not explicitly included in trade agreements) further strengthen the competitiveness of Mexico's transport sector.

A second aspect from the Mexican experience that is worth highlighting is that not all manufacturing sectors can offer the same opportunities for successful industrial development and integration in international production networks. Inducing the industrial development of firms within Electronics, Textiles and Other manufacturing will guarantee the presence of the immediate set of benefits for developing economies (output, employment and FDI). Those three sectors, however, will play a very limited role in transforming the export sector towards more technologically advanced activities. The governance of the manufacturing production within those three sectors, as well as the specific incentives for multinational firms to reallocate specific labor-intensive activities to developing economies account for this issue. Transportation equipment sector stands as a clear exception to Mexico's attempt to substantially transform its domestic manufacturing capabilities. Unique access to major foreign end markets, growing Mexican middle class, the existence of protectionist rules of origin and, so forth, were factors that led to a successful transformation within this sector. In a nutshell, the Mexican experience highlights that the manufacturing sectors that can induce a complete and successful industrial transformation are those where the developing economy can fully exploit its country specific competitive advantages and, that are not subject to stiff global competition.

The third important aspect from the Mexican experience is that successful production for exports does not only imply supporting highly competitive multinational firms. More importantly, any export promoting strategy should also aim to slowly induce the production for exports from those domestic firms that are currently mostly producing for the domestic market. Any developing country seeking to strength its exporting sector should then devise two export promoting programs; one for the highly competitive firms, and other that aims at the industrial development of domestic firms seeking to produce for exports. Each export promoting program should provide different trade and tax incentives based on realistic performance requirements for the firms there participating. Those two programs have to coexist with one another and, the differences in performance requirements between them should slowly be lifted. Once the export promoting program for domestic firms has proven successful, the final objective of policy makers in developing economies should be then to merge those two export promoting programs into a single framework to further strength the competitiveness of its manufacturing sector.

The target audience for this dissertation is not strictly limited to policy makers. Scholars seeking to understand (and test) the different set of alternatives that developing economies face to join and upgrade in global value chains would also greatly benefit from the main ideas and conclusions discussed by this Ph.D. dissertation. Long term empirical perspectives on the firm-level and aggregate trends of exporting firms make this thesis unique on the field of international trade. The results from this dissertation have been presented at international conferences and at seminars in Universities and Policy institutions. Chapter 4 has been already published as a journal article at the *Journal of International Trade and Economic Development*, while Chapter 3 and 5 are part of the UNIDO Inclusive and Sustainable Industrial Development Working Paper Series.

About the Author.

Juan Carlos A. Castillo Sánchez was born in Mexico City. He conducted his PhD studies in UNU-MERIT, Maastricht University (2018), under the specialization track on “Structural Change and Industrialization” which was sponsored by the United Nations Industrial Development Organization (UNIDO). He also holds a Master’s degree in Economics and Business (research) from the University of Groningen in the Netherlands (2012) and, a *Licenciatura* degree in Economics (honors) from the National Autonomous University of Mexico (2009). During his PhD studies, he also acted as a tutor for several bachelor level courses (International Economics, Network Economics and, Macroeconomics), as well as a master level course (Innovation). As a research intern for UNIDO and, as a consultant for the United Nations Conference on Trade and Development (UNCTAD), he provided technical assistance for two major policy reports; UNIDO’s 2016 Industrial Development Report and, UNCTAD’s 2018 World Investment Report.

His main areas of interest are manufacturing micro-level datasets, global input-output systems, multinational firms, industrial policy, global value chains and export processing zones.

General Appendix.

Data sources used in this Dissertation.

GA. 1. Introduction.

This appendix briefly summarizes all the sources of information we relied on during the different empirical chapters from this dissertation. In general, this thesis utilized two types of data which are aggregate information and firm-level datasets. Let us explain now the exact information contained on each type of data.

Aggregate information refers to the following; (a) multiregional Input Output tables (IOTs) (the EORA and the WIOD dataset); (b) national IOTs for the Mexican economy for the base year of 2003; (c) international trade statistic for Mexico per product category at the 8 digit level (Harmonized System) by country of origin (imports) and by country of destination (exports); (d) information per manufacturing sector for gross output, gross value added, domestic and imported intermediate consumption (reported in line with Mexico's National Accounting System), as well as; (e) information for the qualification of labor. One important advantage from this dissertation is that the aggregate data for the case of Mexico (items b to e) was available according to three categories which are the total economy of Mexico, domestic manufacturing and Maquiladora industry. Since information for Maquiladora is only available up to 2006, our research also employed two additional sources of aggregate information to further extend the analysis of Mexico's exporting sector up to more recent years. These two additional aggregate datasets are; (f) the concept of Manufactura Global, which is Mexico's statistical office latest attempt to measure the participation of firms located in Mexico in international production networks from 2003 onwards, and; (g) official information for the new exporting framework that replace Maquiladora by 2007 which is known as the IMMEX program. One important thing to mention from these last two aggregate datasets is that they also offer time series information per manufacturing sector for different years. Nevertheless, only the concept of Manufactura Global reports information in line with Mexico's National Accounting System (NAS). Thus, to match our IMMEX data with our information for Maquiladora as close as possible, our research had to create its own definitions to measure variables such as gross output and gross value added.

Firm-level information refers to official (unbalanced) panel datasets for exporting firms published by Mexico's statistical office (INEGI) under rather strict confidentiality issues. Here, we utilize two datasets which are the one for Maquiladora firms (1990-2006) and the one for IMMEX firms (June 2007-2014). The Maquiladora panel dataset reports information in the same fashion as the previously described aggregate Maquiladora statistics, which means that firm-level information for this dataset is also reported in terms of Mexico's NAS. On the other, as previously mentioned, IMMEX data at the firm-level does not follow either the methodology from Mexico's NAS. Henceforth, the methodology we used to build concepts for IMMEX data at the aggregate level was also followed at the micro-level.

Depending on the specific set of objectives from each chapter in this dissertation, we utilize different combinations of aggregate datasets, as well as a combination of both aggregate and firm-level dataset at the same time. For instance, chapter three relied on aggregate item (a), chapter four used items (b) (d) and (e), chapter five employed items (a), (b) (c), (d) and (f), while chapter six utilized aggregate items (d) and (g) as well as our two firm-level datasets. The forthcoming paragraphs explain in detail the specific characteristics from each type of data that we utilize according to each chapter in this dissertation.

GA.2 Data sources for Chapter 3.

The main objective of this paper was to decompose final output produced by top exporters and regions of the World economy into the value added contribution from different countries. Given that these objectives implied analyzing all the international production networks in the World, we decided to use the EORA multiregional IOT dataset. Following Lenzen et al. (2013), the EORA dataset covers the inter-industry flows between more than 187 countries from 1990 to 2011. To construct such large dataset, Lenzen et al. (2013) relied on different data sources such National Accounting dat provided by different UN agencies, the COMTRADE databases, Eurostat, IDE/JETRO, as well as a great number of national agencies. Information within the EORA dataset is provided both for basic and purchaser's price.

GA.3 Data sources for Chapter 4.

This chapter projected official IOTs for the Maquiladora industry and for domestic manufacturing for a period of 25 years. To meet this objective, we relied on the following information; (1) official IOTs for the total economy of Mexico (base year) and; data from Mexico's national accounting system from 1981 to 2006.

GA. 3.1 Official IOT for the Total Economy of Mexico (2003).

In 2008, INEGI released an IOT (with the base year 2003) for the total Mexican economy. An important novelty was the fact that INEGI decided to divide such IOT for the total economy into two main components; (1) the Maquiladora industry and, (2) the Domestic manufacturing of Mexico. Such situation means that for the year 2003, Mexico provides one specific IOT to study the Maquiladora and one specific IOT to study Domestic manufacturing.

In line with INEGI (2010), maquiladora firms are defined as the economic units that perform activities for assembling and/or transforming intermediate goods that have been temporarily imported and whose processing is meant to produce a manufacturing good that is to be exported. Following the same reasoning, domestic firms can be defined as all those economic units within the Mexican territory that do not belong to the maquiladora program. Specific supply and Use tables for Maquiladora and of the domestic economy were used by INEGI to construct the respective IOTs. All the data is there reported in basic (and purchaser's) price for 20 manufacturing sectors (and 79 subsectors) which are classified in line with the North American Industrial Classification System (NAICS) (INEGI, 2011b).

GA.3.2. Data from Mexico's National Accounting System for Maquiladora and Domestic Manufacturing (1981-2006).

Projecting IOT for Maquiladora and for the domestic economy of Mexico required retrieving complementary information from Mexico in terms of its National Accounting system (NAS). Information for gross output, gross value added, domestic and imported intermediate consumption, as well as for blue-collars and white-collar workers was readily available from 1990 to 2006 (http://www.inegi.org.mx/sistemas/bie) both for Maquiladora and for domestic manufacturing. As for the case of information from 1981 to 1989, information in line with the NAS was only available online for the case of domestic manufacturing. Thus, to obtain information for that same period for Maquiladora firms, we digitalized hard copies from old documents published by INEGI that were not accessible via the internet (INEGI, 1991).

Finally, once we gathered all the necessary information, we projected IOTs for domestic intermediate consumption and for imported intermediate consumption (for each component from Mexican manufacturing) by relying on the aforementioned official IOTs and using the G-RAS procedure (Temurshoev and Timmer, 2011).

GA.4 Data sources for Chapter 5.

In this chapter, our research divided Mexico, as presented by the World Input Output Tables dataset (WIOD), into Mexican domestic manufacturing and Mexican maquiladora industry. To meet this objective, we relied on the data created in chapter 4 and required the following data additional: (1) WIOD dataset; (2) data reported in terms of the NAS for domestic manufacturing as well as the new statistical concept to measure Mexico's participation in international production networks from 2007 to 20111, and; (3) International trade statistics for each component of Mexican manufacturing.

GA.4.1 World Input Output Database (WIOD): 1998-2011.

On its 2012 release, WIOD included 40 developed and emerging economies that together represented more than 85% from the total World GDP (Timmer et al., 2014). Furthermore, along with those 40 economies, WIOD also includes in the dataset a representative developing economy categorized as the rest of the World. Such information is provided from 1994 to 2011 (2012 release). When compared to other multiregional IOT datasets, one important advantage from WIOD is the fact that such dataset relies on the official information provided by National Statistical Offices to construct its data. This official information (in terms of gross output, imported intermediate consumption and so forth) is then linked by means of international trade statistics to describe multiregional inter-industry flows across countries.

GA.4.2 NAS Data for Domestic Manufacturing (1998-2011), for Maquiladora (1998-2006) and the Concept of Manufactura Global (2007-2011).

As mentioned before, aggregate information for Maquiladora firms reported in terms of Mexico's NAS is only available online from 1981-2006. Given the time period covered by WIOD on its 2012 release (1994-2011), and the available international trade statistics for Maquiladora (1998-2006), we could only use such NAS Maquiladora information from 1998-2006. The next challenge for our research was obtain data to study NAS Maquiladora from 2007 to 2001. INEGI (2014) published a new statistical tool to measure Mexico's participation in global production networks which is called "Manufactura Global". From the whole universe of manufacturing firms in Mexico, INEGI (2014) identified those firms that belong to international production networks if they meet one of the following criteria; (a) their production should be for exports and most of their imported inputs should be imported (a ratio of 2/3 with respect to their exports); (b) they should be mostly foreign owned, and; (3) they should produce intermediate goods that are exported for the production of other international production networks not located in Mexico. By definition, Maquiladora firms (within the framework of IMMEX) are included in the statistical concept of Manufactura Global. Similarly, given that Manufactura Global data is reported in terms of NAS from 2003 to 2014, we decided to use the information from 2007 to 2011 to account for the necessary data to study the participation of Mexico in international production networks from 2007 to 2011. As for the case of data from domestic manufacturing, we faced no major difficulties in obtaining such data from 1998 to 2011 as it is readily available at INEGI's official website. With all the required information for Manufactura Global and for domestic manufacturing, we projected IOT for each component of Mexican manufacturing from 2007 to 2011 using the same methodology proposed by the G-RAS procedure. By adding these new projected IOTs to the ones we previously created in Chapter 4, we obtained an updated IOT dataset with information from 1994 to 2011 which was necessary to divide Mexico as reported by WIOD.

GA.4.3 International trade statistics for Maquiladora and for Domestic manufacturing (1998-2011).

Detailed data for exports and imports per product category at 8 digit-level from the Harmonized System is available for each of two components from Mexican manufacturing from 1998 to 2006[50]. This means that during that period of time, INEGI reported specific data for exports and imports for Maquiladora and for domestic manufacturing, respectively. Nevertheless, as of 2007 such distinction is no longer made and INEGI only reports data for exports and for imports per product category. In light of this situation, our research could only initially divide Mexico as reported by WIOD from 1998-2006. One new challenge to extend the analysis from 2007 to 2011 was to identify from Mexico's available trade statistics those product categories that belong to Manufactura Global and those that belong to domestic manufacturing. To meet this objective, we follow the same methodology that INEGI (2014) followed in order to identify firms belonging to Manufactura Global. From the previous statistics that separately studied Maquiladora and Domestic manufacturing, we built a ratio of Maquiladora to total manufacturing. If the ratio was higher than 2/3, i.e. more than 70%, (both for the case of exports and imports respectively) we conclude that such product category belong to Manufactura Global. Those items that do not meet such criterion (a ratio of Maquiladora to total manufacturing lower than 2/3) were then regarded as product categories belonging to domestic manufacturing. Once we obtained the

[50] http://www.inegi.org.mx/est/lista_cubos/consulta.aspx?p=adm&c=9

respective lists of product categories at the 8 digit-level, we utilize it to identify data for exports and for imports for Manufactura Global and domestic manufacturing.

GA.5 Data sources for Chapter 6.

In this chapter, we analyze labor productivity and labor productivity growth in total manufacturing, domestic manufacturing and the exporting sector at the aggregate and firm-level. At the aggregate level, this chapter utilizes three sources of information per year and per manufacturing sector (available at www.inegi.gob.mx). The first source of information is data from Mexico's total manufacturing (1990-2014). The second source is data for Maquiladora retrieved from EMIME (1990-2006) and, the third one is information for the IMMEX program (available from July 2007 to 2014). Our estimates for domestic manufacturing were always obtained as the difference between the data for total manufacturing and the one for exporting firms (Maquiladora or IMMEX program), respectively.

For maquiladora firms, gross value added was computed as the sum of labor remuneration, utilities and the rental cost of machinery and equipment. For the same set of firms, intermediate consumption was regarded as the sum of imported and domestic intermediate goods and total intermediate expenses. The sum of gross value added and of intermediate consumption provides our estimate of maquiladora gross output. On the other hand, information for IMMEX was more difficult to compute. Unlike EMIME, IMMEX does not publish data entirely in line with the NAS. In this context, following the concepts from INEGI (2012) and the information provided in the official IMMEX industrial surveys, gross value added had to be computed as a residual. From the IMMEX variable named "Ingresos por Maquila, Submaquila and Remanufactura[51]" (i.e., income obtained as a result of maquiladora-related operations) we subtract the value of domestic intermediate inputs. The residual of this computation is our measure of gross value added for IMMEX firms. Gross output for IMMEX firms was regarded as the sum of the variable named income obtained as a results of maquiladora related operations and the variable accounting for imported intermediate consumption. Total intermediate consumption for IMMEX were computed following the same procedure as for maquiladora firms. Once we obtained all this information for total manufacturing, Maquiladora and IMMEX, value added and output deflators were utilized to present such data in constant Mexican pesos of 2008. Finally, for the case of variables measuring employment, we faced no major difficulties since INEGI directly publishes such information for total manufacturing, Maquiladora firms and firms under the IMMEX program.

For our micro analysis, our research will rely on two official unbalanced firm level data sets collected and compiled by INEGI; the first one is the EMIME (maquiladora) firm level dataset from 1990 to 2006 and, the second one is the IMMEX firm level dataset (July 2007-2014). Both EMIME and IMMEX, report their own official variables at the aggregate and firm-level. Therefore, our own firm-level variables for EMIME and IMMEX

[51] In line with "Cuestionario Mensual para Establecimientos Manufactureros-Programa IMMEX", the variable named "Ingresos por Maquila, Submaquila y Remanufactura" is computed considering the sum of production costs (labor, depreciation of capital, domestic inputs, etc.) plus total expenses and utility.

were computed following the same procedure as in the aggregate section (4). Let us explain in detail the characteristics from each firm level dataset.

The full EMIME firm-level dataset consists of 34,728 plant year observations (1990-2006). For each plant, there is information on hours worked and the number of employees by job category (administrators, technicians and workers), wages paid by job category, as well as plant expenditures, domestic and imported intermediate consumption, value added, utilities etc. The EMIME dataset also contains one variable related to capital expenditures named “expenditures on machinery and equipment”. According to Utar and Ruiz (2013), such variable refers to firm-level domestic expenditures on precision and resistance instruments, rotation bands, forklifts and, trucks with special containers (temperature and toxic waste). EMIME does not report plant-level information on owned imported capital equipment. The full IMMEX dataset consists of 41,500 observations (July 2007 to December 2014). Plant level data for wages, number of employees, hours worked is also reported by job category. Nevertheless, unlike EMIME, IMMEX only reports such data for two job categories, namely technicians and workers (reported in a single category) and, administrative staff. Similarly, IMMEX reports two different income categories that a given firm might obtained either from domestic or foreign market operations. Here, we are referring to the categories of income obtained as a result of maquiladora related operations (ingresos por maquila, submaquila y re-manufactura) and, the one for other income. IMMEX data for plant expenditures is less detailed than the one for EMIME. For instance, there is no IMMEX variable that directly quantifies firm-level expenditures on capital. Finally, IMMEX micro data for domestic and imported intermediate are reported in a similar fashion as EMIME

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